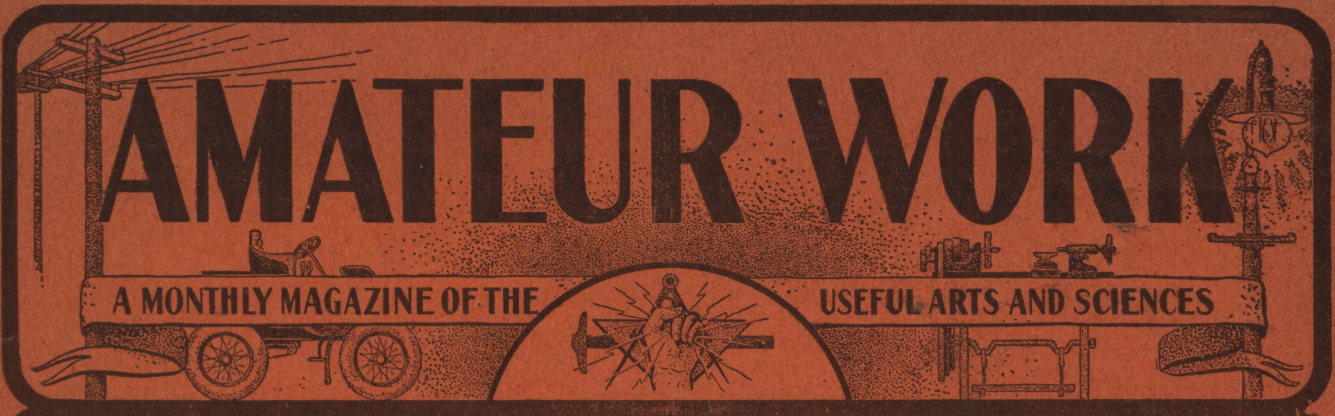

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. III. No. 10 AUGUST, 1904 Ten Cents a Copy

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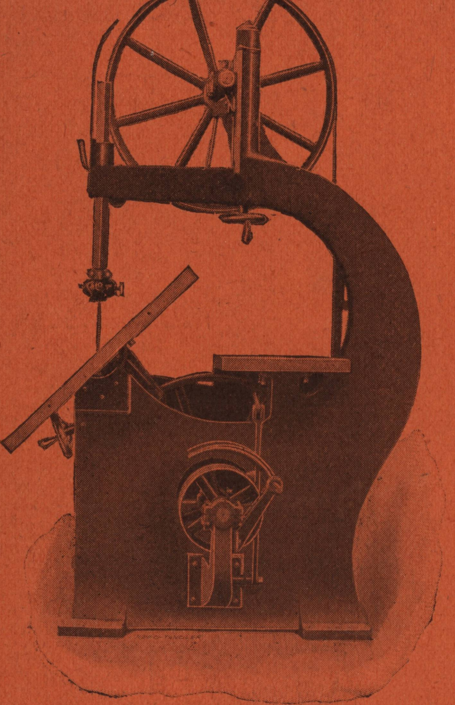

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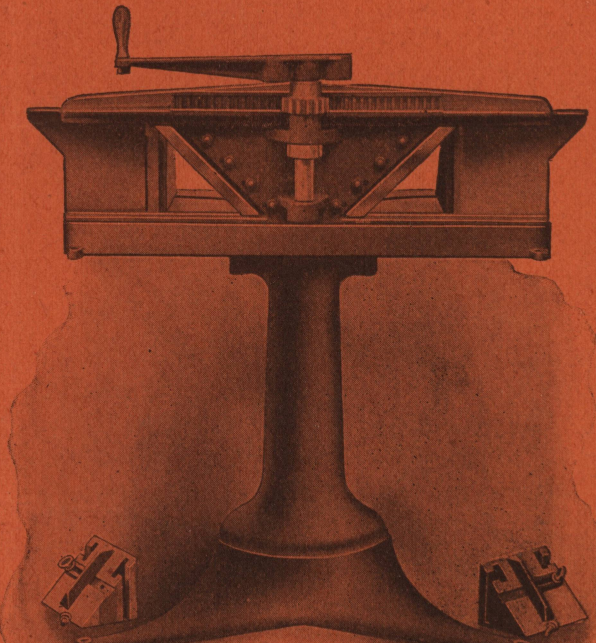

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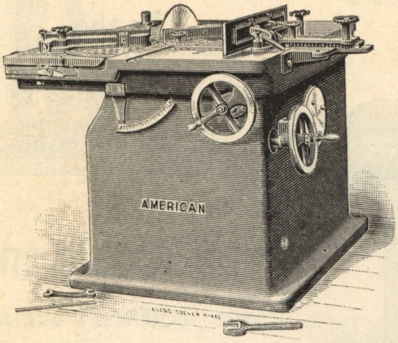

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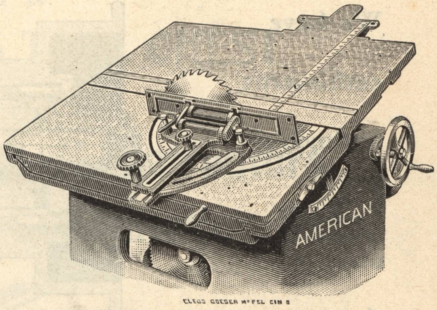

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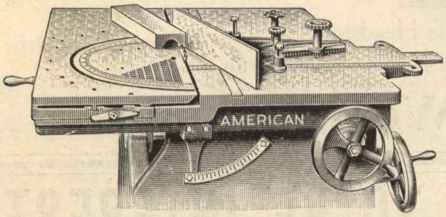

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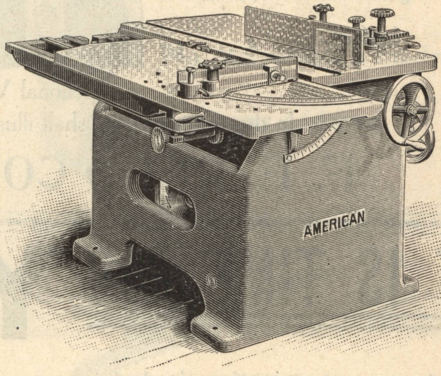

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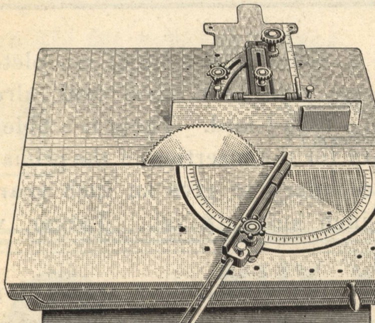

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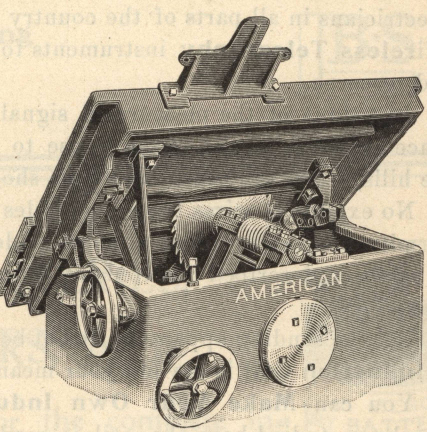

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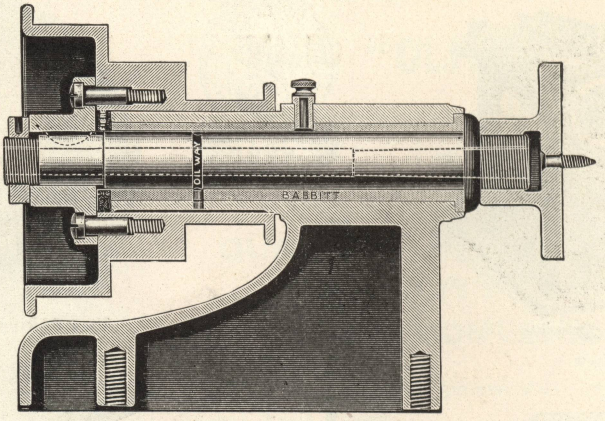

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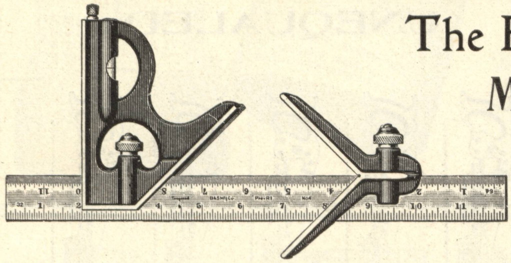

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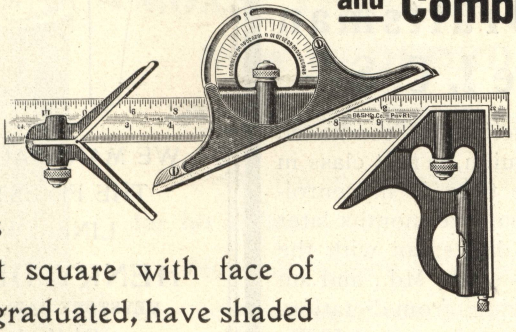

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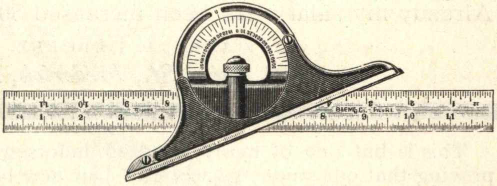

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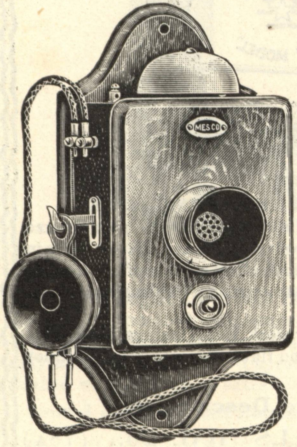

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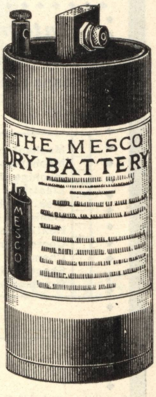

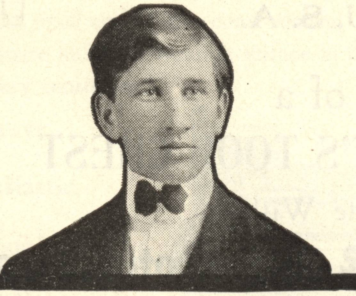

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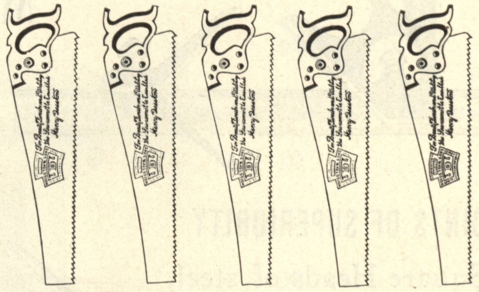

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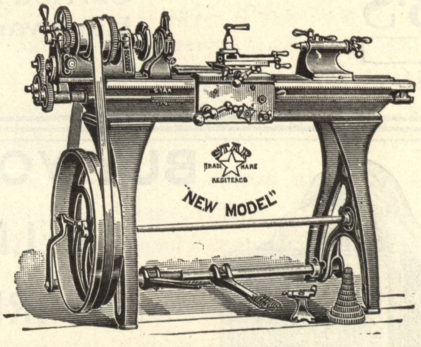

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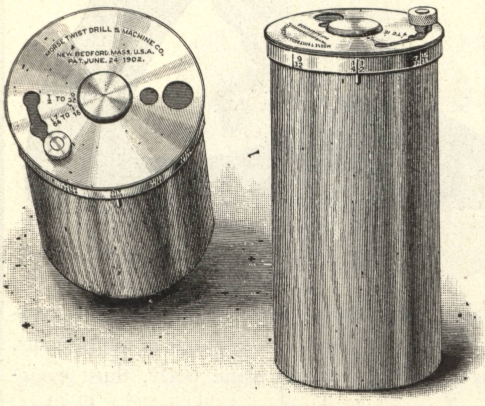
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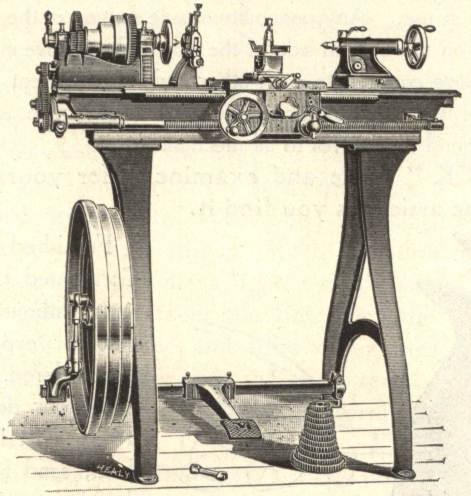

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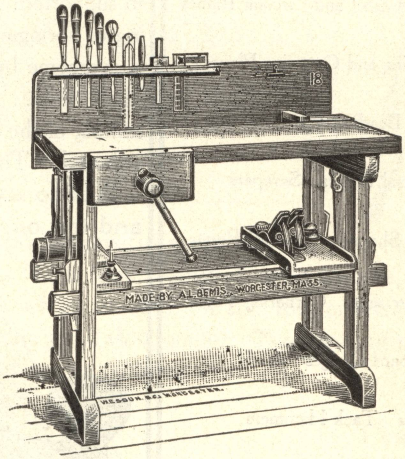
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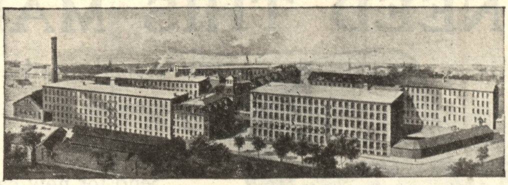

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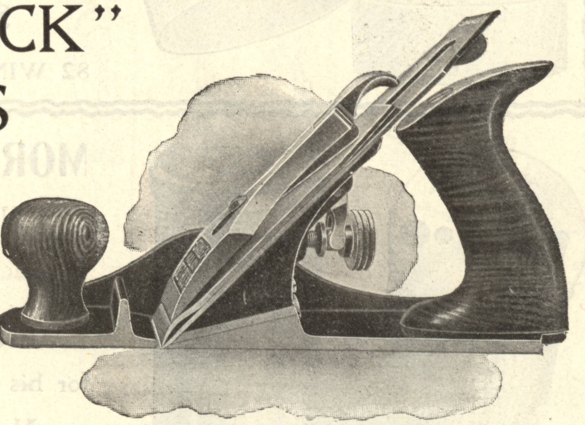

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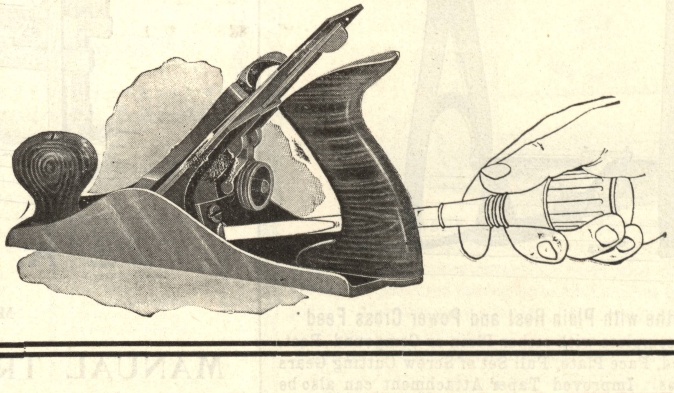

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A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. III. No. 10. BOSTON, AUGUST, 1904. One Dollar a Year.

A TELEGRAPH TRANSMITTER.

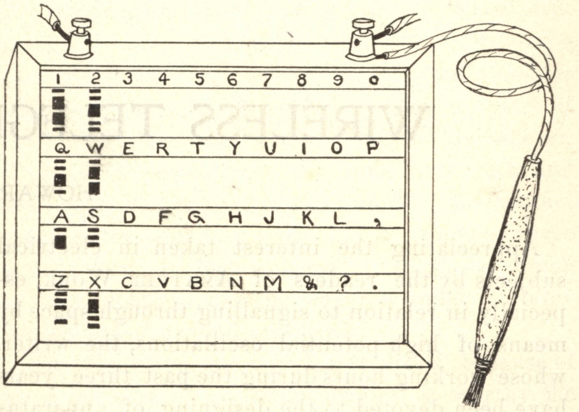
FREDERICK A. DRAPER.

Those interested in wireless telegraphy experiments who have not learned the Morse code, and yet desire to transmit messages, can do so by means of the simple arrangement here described, which closely resembles the original device used by Prof. Morse in the early days of telegraphy.

A frame made of plain picture-frame moulding should be purchased. The inside measurements should be about 6x8 in. A piece of sheet brass is then cut to fit inside the frame, in the same way that a piece of glass would be fitted for a picture. Also a piece of 4-ply white Bristol cardboard of the same size is cut, and then on one surface marked lightly with a pencil to show the inside edge of the frame.

Across the cardboard in the longer dimension draw lines with India ink, the first one $\frac{3}{8}$ in. from the line showing the edge of the frame, the second one $1\frac{1}{8}$ in. from the first line, then $\frac{3}{8}$ in. followed by a $1\frac{1}{8}$ in. space, etc., marking off four spaces of each width. With the first narrow space at the top, mark lightly with a pencil a vertical line, $\frac{1}{2}$ in. from the line showing the left edge of the frame, and nine other lines $1\frac{3}{16}$ in. apart. On either side of these ten lines make other pencil lines $\frac{1}{8}$ in. away, forming spaces $\frac{1}{4}$ in. wide.

Directly over the centre lines just mentioned and in the $\frac{3}{8}$ in. space across the sheet, mark in India ink the figures and letters as shown in the illustration, this being a typewriter arrangement to avoid the excessive movements that would be required by an alphabetical one. The lettering should be heavy that each character may be easily read. Holes are then cut through the cardboard under each character with a sharp knife, the sizes varying to represent the dots and dashes. The horizontal ends of the holes should be on the lines on either side of the centre line under the letter, making them uniformly $\frac{1}{4}$ in. long. The vertical length must be carefully marked out to a uniform scale, that for a dot being of unit length, and a unit of about $\frac{3}{32}$ in. will, on the longer letters, require all the available space. The spacing should be marked out as follows:



Signal.	
Dot	1 unit.
Dash	3 units.
Long dash	5 units.
Very long dash	7 units.
Space in letters	1 unit.
Space in spaced letters	3 units.
Space between letters	3 units.

Also, when using the transmitter, the spacing between words should be a time interval represented by six units. To illustrate the unit spacing, take figure 1 at the left end of the top row comprising dot, dash, dash, dot:—for the dot cut a hole $\frac{3}{32}$ in. long; $\frac{3}{32}$ in. below this hole cut anotber for the dash $\frac{9}{32}$ in. long; $\frac{3}{36}$ in. below this cut another for the second dash of the same length, and $\frac{3}{32}$ in. below this a hole $\frac{3}{32}$ in. long for the second dot. The top edge of the upper hole of each character should be but on the cross lines under each character. When all the holes have been cut a stencil is formed which is then given a coat of spirit shellac on each side, that on the under side being put on last and as quicely as possible, so that, while the shellac is still moist, the stencil can be placed upon the sheet of brass, smoothed down to get a firm contact, and allowed to dry in position. In a short time the stencil will be found firmly united to the brass, which may be seen through the holes. Should any shellac work out into the holes it should be removed with the point of a knife. The stencil and plate are then put in the frame and fastened the same as for a picture.

Two binding posts are now mounted on the upper edge of the frame, the base of the one on the left being connected with the brass plate, that on the right with a piece of flexible conductor, the other end of which is put through a cork penholder with about one inch of the conductor protruding at the lower end. Enough of the wire from a piece of the conductor is cut into short lengths and formed into a brush at the end of the pen-holder, by winding a number of turns of wire around the base of the brush, and the transmitter is complete.

To use it, the line wires are connected to the binding posts, the brush is carried across the holes under the characters with slow, steady movements, the circuit being completed when on the brass and broken by the cardboard strips between the holes. A little practice will enable anyone to send an accurately spaced message. A description of a tape receiver operated by clockwork will be given at an early date.

WIRELESS TELEGRAPH APPARATUS.

HOWARD W. RICE.

Appreciating the interest taken in electrical subjects by the readers of AMATUER WORK, especially in relation to signalling through space by means of high potential oscillations, the writer, whose working hours during the past three years have been devoted to the designing of apparatus for the highest of induced voltages, takes pleasure in contributing a few personal observations bearing directly upon the sending and receiving ends of experimental wireless stations, such as an amateur would use in connection with a spark coil of moderate size at the sending end.

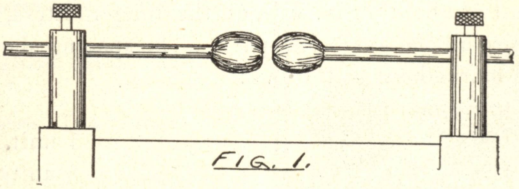


FIG. 1.

Without committing myself to any one of several good systems now on the market, one cannot but be in sympathy with the sending equipments that in personal tests have shown up the best. For example, some wireless electricians now in the employ of private and governmental institutions favor one "disperser" because of the noiseless operation, yet equally well posted men would prefer results attending the racket of more vigorous oscillations at the spark gap.

Let us consider in this article that the amateur possesses an induction coil giving about an inch spark or over when operated by a few cells of battery. The spark gap is made of two brass pieces shaped as in Fig. 1 and separated less than $\frac{1}{8}$ of an inch.

Fig. 2 shows the transmitting circuit, *A* being a Leyden jar constructed of a pint battery jar coated inside and out in the usual way with tin foil. The circuit, *X*, as marked by heavy lines, consists of a bundle of soft iron wires, 6 in. long and $\frac{3}{4}$ in. in diameter, on which is wound the entire length, two layers of No. 12 copper wire, heavily insulated with three or more coatings of cotton thread and the layers separated by a layer of thin mica. Over this primary is wound two more layers of mica and five layers of No. 16 cotton covered wire, each layer being separated by a layer of mica, and the wire wound not too snugly together in turns. This coil is to convert the waves that oscilate at the spark gap to a still higher intensity, and the entire windings must be kept in a jar filled with parafine or similar insulating oil.

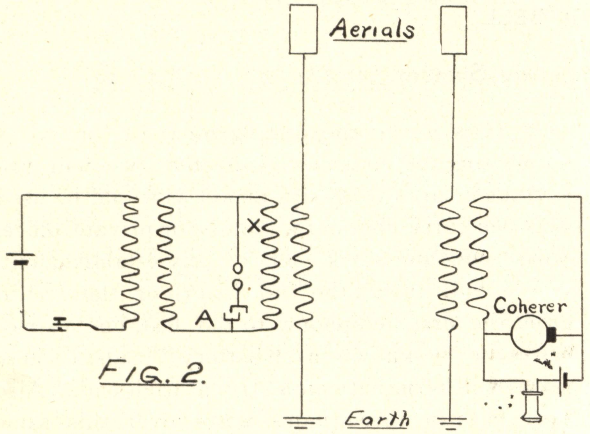


FIG. 2.

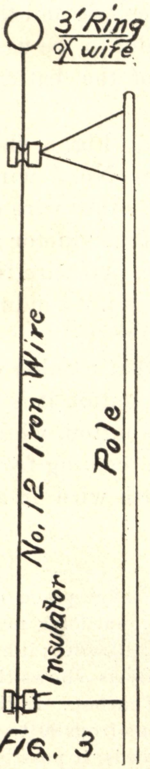


FIG. 3

One terminal of the coil connects with the aerial and the other with the ground plate. This ground plate may be a coil of wire or a sheet of metal, but must be buried where the earth is constantly moist or wet. The aerial must be insulated and suspended, as in Fig. 3.

The receiving circuit is similar to one used in a very successful type of apparatus, and worthy of following in the construction of apparatus for home experiment. The coil, which is in the circuit with the receiving aerial, is constructed with an iron wire core $\frac{3}{8}$ in. diameter and 9 in. long. The primary is two layers of D. C. C. No. 18 copper wire, insulated with one turn of paper between layers, and four turns of paper between primary and secondary. The secondary consists of six layers of 36 D. C. C. wire separated by one sheet of thin paper between each layer. This coil may also be immersed in oil.

The coherer herewith illustrated, Fig. 4, is intended for use with a telephone receiver and not with a relay and sounder circuit. As many readers would prefer to experiment with different types of coherers, several types will be illustrated in another article. This type, however, will give excellent results.

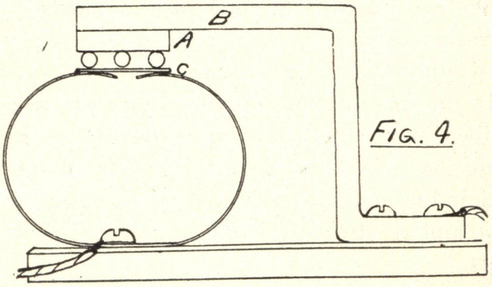


FIG. 4.

The spring is a flexible clock spring, bent in the form of a hoop three inches in diameter. *A* is a block of polished carbon, *B* is a metal support, *C* is a flat disc of aluminum. Between the two are placed three polished steel balls such as are used in bicycle bearings. The pressure of the spring keeps the balls in place. This coherer, if properly constructed, responds in buzzes, and the length of the buzz is regulated by the contact made at the sounding key. It has operated three miles with perfect success. Doubtless much greater distance can be covered under suitable conditions of ground and aerial.

The foregoing set commends itself because of its simplicity of construction and is worthy the attention of all amateurs.

More opportunities for the alternator follow in the wake of the steam turbine. *Power* says that a curious side issue from the increasing use of steam dynamos is that the dynamo with its commutator is being discredited, whereas, an alternator is, if anything, easier to design for high speed than it is for low speed. Many engineers contend that the commutator is quite impossible for large steam turbines, and it appears that if direct current is required from a large power station in which steam turbines are employed, it is necessary, or at any rate advisable, to instal turbo-alternators and rotary converters. The alternators would be wound for low voltage to avoid the step-down transformers.

TELEPHONE CIRCUITS AND WIRING.

ARTHUR H. BELL.

An Intercommunicating System.

In manufacturing establishments, schools, apartment houses and hotels, the intercommunicating telephone furnishes the most direct means of conversation between manager and workrooms, principals and subordinates, tenants and landlords.

In the installation of the equipment here described, particular attention is devoted to simplifying the telephone sets themselves, dispensing with induction coils and magneto signaling apparatus, and all strap keys and complicated hook contacts.

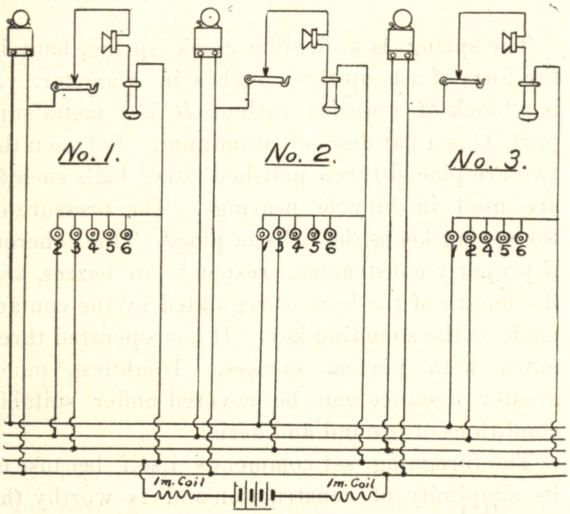


Fig. 8 illustrates one telephone set as used with this system. First there is a vibrating bell or buzzer of a type usually sold by dealers for door bell and general signalling. A pair of wires are connected with the bell binding posts. The terminals of these wires are to be connected later on to the main line wires.

One side of the bell is directly connected with an automatic hook which on upward contact, that is, when the receivhr is removed from the hook, puts the transmitter and the receiver in series circuit. The other side of the receiver takes a certain point of connection on the main line wiring. A series of push buttons is arranged, as shown in the sketch, for signalling purposes.

In considering the arrangement of line wires connecting the instruments together we will undertake a three party equipment as would be used between three floors of a factory or private office, work room and stock room of any establishment.

We will install the full length of the circuit, from the first telephone to the last, one pair of wires to be known as "battery" leads. These wires will terminate on a strip at each end. Also will be run three more wires over this same course. It will be advisable, if possible, to use different colored wires (annunciator) so that any one wire can be singled out for testing or connection of wires. This is not difficult to arrange, as annunciator wire comes in various colors, and the exact amount of wire of each color to be used may be estimated by the length of the battery leads previously installed.

It will be noticed in the diagram, Fig. 8, that one wire leading from the bell takes No. 5 wire, *i. e*,, the lower battery lead and the other wire of the bells takes the same number of conductor as is its station number. For example, bell wire for No. 1 station takes No. 1,; 2 takes No. 2 conductor, etc.

One side of a push button takes that number of conductor as is the number of the station it is to ring, and the other side or the push button, which is a common wire, takes the wire coming from the receiver, which takes the fourth wire in all cases.

A valuable anthracite discovery has taken place on the boundaries of the Canadian National Park near Banff. The seam is already known to run 10 miles; it has a solid thickness of 10 ft., and an analysis shows the coal to contain from 75 to 80 per cent of carbon. In the Pennsylvania anthracite the carbon runs from 80 to 88 per cent. In the face of such finds, how is it possible for certain croakers to fix a limit to the world's fuel store and prophesy the speedy exhaustion of the coalfields? There may be ten times as much coal yet to be discovered as they at present have any knowledge of.

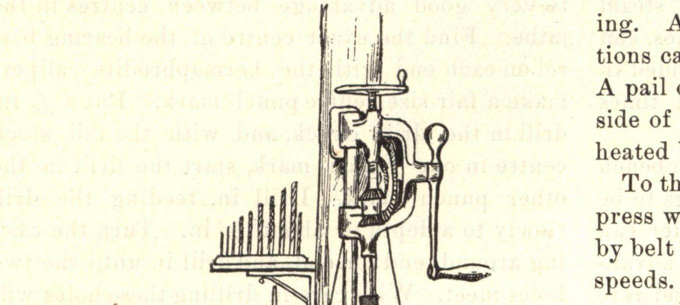
HANDY HINTS FOR AMATEURS.

Contributions are solicited for this department, and for each accepted article the sender will be given the choice of any one-subscription premium from our premium offers.

A HANDY COMBINATION.

R. G. GRISWOLD.

The enclosed sketch shows a very handy combination for the amateur's shop which takes up little room and has a number or points to recommend it. In the first place, the three tools are operated from one driving wheel, the operator standing in any position necessary to properly execute the work in hand.



To the left is shown a scroll or jig saw, mounted on a rigid arm and having a brace running from a wall behind to prevent vibration while cutting. The table can be tilted to cut bevels. The treadle which drives the fly wheel when the saw is in use is of such length that the operator does not have to reach out with his foot, the length making the angular motion of the foot less and not so tiring. The tread is made wide, to accomodate both feet when sitting for extensive operations or for either foot while standing, without shifting the position of the body.

To the right is shown a grinding and polishing attachment, operated by the same driving wheel. This grinder accomodates several sizes of wheels and a series of buffs and brushes can be attached to the spindle opposite the wheels used for grinding. A rate of ten or twelve hundred revolutions can be readily maintained without fatigue. A pail of water should hang on the right hand side of the grinding shelf to dip tools into when heated by grinding.

To the front of the post is attached a hand drill press which has also an attachment for driving by belt for the small drills which require high speeds. To the left of the drill is shown a shelf upon which a set of drills can be kept and easily reached when needed. Directly beneath is an oil can, placed on the left so that it may be used without taking the right hand from the drill press handle.

The driving wheel should be made very heavy to maintain a steady speed when the tools are working. While all three belts are shown on the driving wheel at once, it is only intended that one belt at a time shall be used, as to run the remaining tools, while working on one, merely consumes power. Three treadles are provided for the convenience of the operator, the one for operating the drill press being placed on top of the one to the left, thus making a connecting rod unnecessary. When not in use it is held up by small wire hook at such a distance above the under treadle that they will not strike. The three attachments are thus compactly mounted, have a solid foundation, and are all operated from one wheel. The saving of valuable space in the amateur's shop is thus made possible, while the value of none of the tools is impaired in the slightest.

A BENCH GRINDER.

B. R. WICKS.

A small emery wheel about your workshop, house or barn can be made to do a large amount of useful work, such as grinding knives, shears, axes, chisels, plane irons, spoke shave irons, etc., and to the amateur mechanic a tool of this kind will be found to be one of the most useful to be found in his workshop, as it can be used for grinding off uneven places on castings when good files would be spoiled; also for grinding lathe tools, drills, counter bores, reames, cutters, and a hundred other uses that present themselves in the course of his work from time to time. No amateur who is engaged in making models of steam or gas engines. electric motors or dynamos, can afford to be without one, as the time expended in making it will pay for itself a hundred times over.

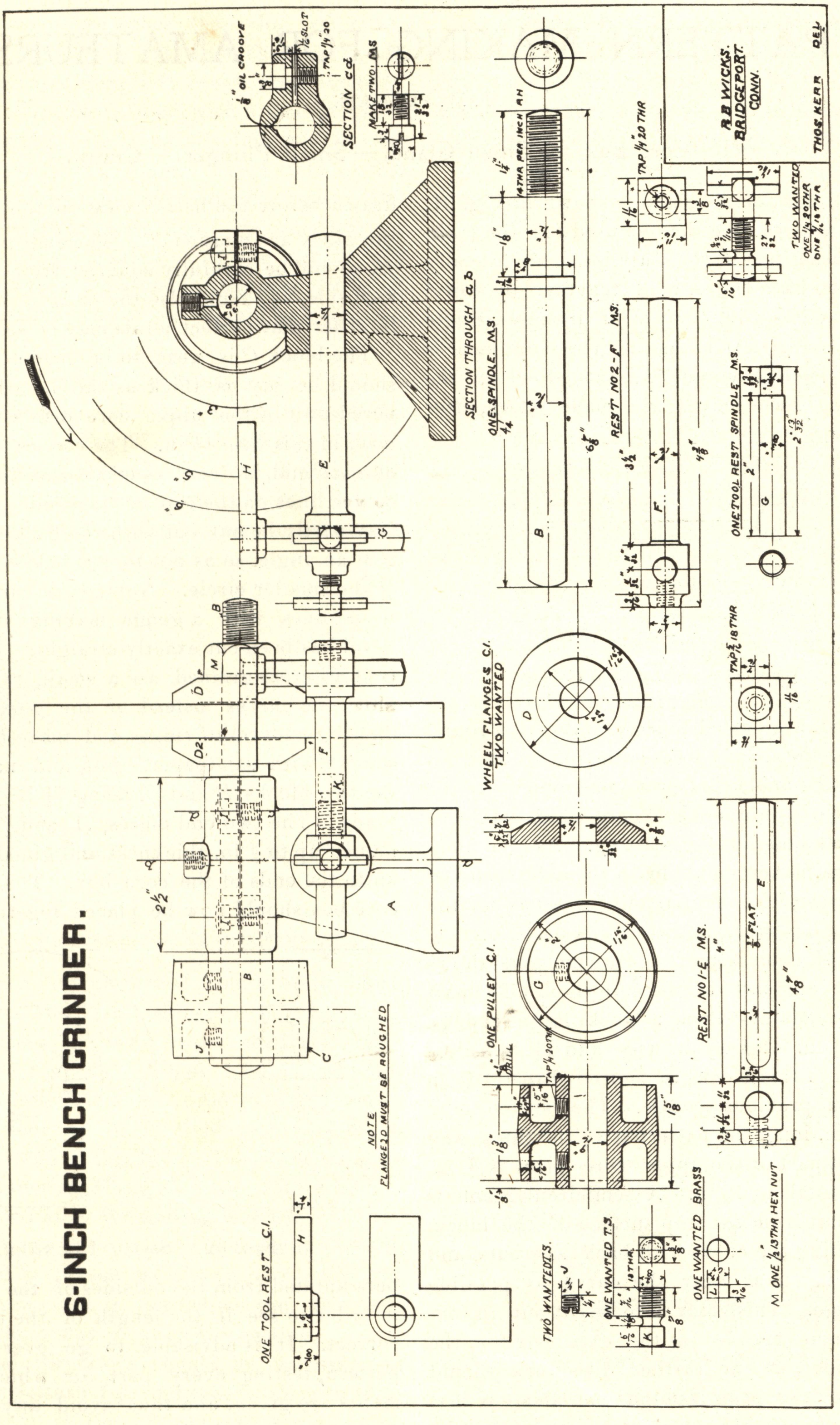
The grinder to be described is a six-inch bench grinder, equipped with all the handy fixings to be found in a modern machine. This grinder can be operated by foot power to very good advantage, or by a countreshaft when motive power is to be had. This grinder is composed of five iron castings: one frame, *A*; one driving pulley, *C*; two wheel flanges, *D* and one tool rest, *H*. The spindle *B*, rest No. 1, *E*, No. 2 *F*, and tool rest spindle *G*, are made from steel. The set screws are all standard thread and are cut off to figures given on detail drawing and $\frac{5}{32}$ in. rods driven through the heads. The two construction drawings show the parts of this grinder in their respective places, and the details below show the parts that are required to construct the grinder, with dimensions and name of parts and material used from which to make them.

In beginning the tooling on the castings the frame or stand, *A*, will first be dealt with. First find the centre of the $\frac{1}{2}$ in. boss of the bearing barrel with a pair of hermaphrodite calipers, and make a light prick punch when the centre has been located. Rub the bottom of the casting with chalk, and set the castings on a surface plate. Set the bearing square both ways with a square, and the needle of the surface gauge or scratch block exactly in the centre of the prick punch mark in the $\frac{1}{2}$ in. boss, and strike a line across the bottom of the casting; this will give one centre line. To find the other centre, set the casting square with the inside of the base and set the gauge needle as before to the prick punch mark and strike another line across the bottom which will give the exact centre of the casting both ways. Centre both the boss and bottom with a small drill, and countersink and face off the bottom of the casting between centres.

The $\frac{9}{16}$ in. hole for the spindle, *B*, is now to be drilled and reamed. This operation can be done to very good advantage between centres in the lathe. Find the exact centre of the bearing barrel on each end with the hermaphrodite calipers make a fair size centre punch mark. Put a $\frac{5}{32}$ in. drill in the drill chuck, and with the tail stock centre in one punch mark, start the drill in the other punch mark. Drill in, feeding the drill slowly to a depth of about $1\frac{5}{8}$ in. Turn the casting around, end for end, and drill in until the two holes meet. With care in drilling these holes will come exactly in line. Remove the $\frac{5}{32}$ in. drill from the chuck, and in its place use a $\frac{1}{2}$ in. twist drill and drill as before. Then put through a $\frac{17}{32}$ in. drill and drill all the way through, reaming out with a lathe reamer about .002 smaller than $\frac{9}{16}$ in. and finish with a $\frac{9}{16}$ in. hand reamer.

Facing the two ends of the bearing can be done with a countrebore large enough to sweep $1\frac{1}{16}$ in. and provided with a $\frac{9}{16}$ pilot, or if the lathe will swing 8 inches a $\frac{9}{16}$ mandrel can be forced in and the ends faced off in the lathe. The length of the spindle bearing is $2\frac{1}{2}$ in. The $1\frac{1}{8}$ in. boss on the front of the casting forms a bearing for the rest No. 1, *E*.

Prof. John Milne has suggested that the displacement of the position of the earth's poles, which is of an irregular kind, and which can be traced to no known law, may be due to movements of the earth's crust, and that, therefore, the magnitude of the change in position of the poles might be expected to correspond in some way to the number and frequency of great earthquakes.



6-INCH BENCH GRINDER.

PATTERN MAKING FOR AMATEURS.

F. W. PUTNAM.

VI. Core Box for Small Gland, — Small Plunger, — Crank.

The core box for the gland is shown in Fig. 31, *A*. Round cores, like the one used for the plain cylinder, described in the July issue, are usually made in two part boxes, held together by dowel pins. For cores 3 in. or over in diameter, single half boxes are generally used. The core sand is packed in the box, wired, and turned out on the core plate. Two halves are made which, after being baked, are pasted together making a round core of just the required diameter. This kind of a box must be made exactly to size, otherwise the two halves will not make a core which will give the required hole in the casting. As the amateur pattern maker should learn to make boxes of this kind, we will make a half core box for the small gland described in the July issue.

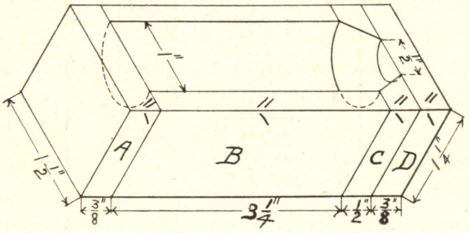


FIG. 31A. CORE BOX FOR GLAND.

Fig. 31, *A*, is an isometric drawing and shows clearly the four parts of the core box. The part *B* is to be made first from a block large enough to finish 3¼ in. long, 1½ in. wide and 1¼ in. thick. Tbe length of this block is figured directly from the pattern previously made. The bottom core print is 1 in. long, the pattern is 1¾ in. thick and the straight part of the upper core print is ½ in. long, or a total of 1¼ in. A semicircular hole is to be cut out from the top surface of the block, approximating the curve with back saw cuts, and then working to as near the curve as possible with a gauge. This block is to be cut out in exactly the same manner as the core box for the plain cylinder, and no further directions should be necessary except to remind the amateur that the centre line of the top surface should first be drawn before the half circles on the ends of the the block are marked out. The ends of the blocks, *B*, should be carefully squared from the top or face side, as should also the ends of the block, *C*, in order that perfect joints may be secured.

The block *C* is next to be made. This block should be just as thick as the length of the tapered part of the upper core prints on the pattern, in this case 1½ in. The circles are marked on each end, the centres coming at the end of the centre lines on the top or face side. The curve may partly be cut out with the back saw, holding it at an angle, so as not to cut below the outline of the smaller circle. Next, work carefully down to the lines with a gouge, making sure that the bevel has been cut exactly straight. If this block is at all cross-grained, use a small, rat-tail file to finish the curves instead of the gouge. Having finally removed all ridges and made the surfaces smooth with sandpaper, glue and nail together the two blocks *B* and *C*, using 1½ in. No. 16 wire brads. The two end pieces, *A* and *D*, are next planed up to ⅜ in. thickness and glued and nailed on to the ends of the core box. The pattern and core box should now be placed together and calipers applied from the outsides of the core prints in order to see if the length of the core box is correct. It is advisable to go over the entire pattern, testing every part for which measurements are given, and thus avoid any possibility of errors. I might say here that usually the out-

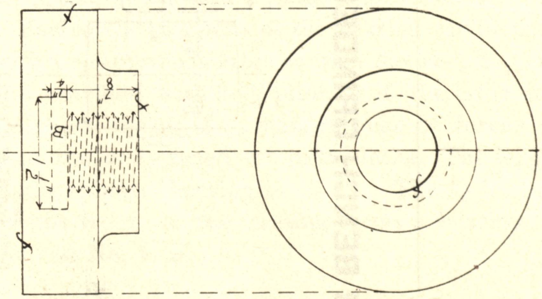


FIG. 32. SMALL PLUNGER.

side of the core boxes, other than the two ends, may have as little work put upon them as possible, in many cases being left rough from the saw, the corners being worked off with a jack plane.

The following rule is usually followed in the making of small core boxes. The length of the core print is to be the same as the diameter. The upper core print is tapered half its length down to half the larger diameter. If the reader will notice the dimensions given for the core prints on the gland pattern, the above should be easily understood.

SMALL PLUNGER.

Fig. 32 shows a small plunger, the pattern for which is shown in Fig. 33. We will use a vertical core with this pattern, therefore *A* will be the top surface of the pattern, the arrow indicating the direction in which the pattern is withdrawn from the mold.

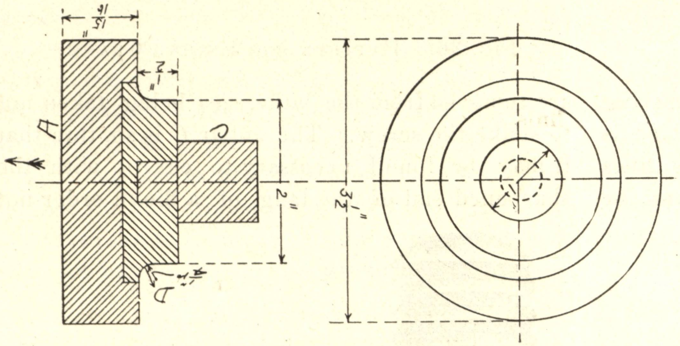


Fig. 33, Pattern for Small Plunger.

The pattern may be turned from a solid block 3¾ in. square and 1⅝ in. thick, or may be made from two pieces, as shown in the sectioned right end view of Fig. 33. A hole 1 in. in diameter and ⅞ in. in length is to be cored out, and also a hollow chamber 1½ in. in diameter and ¼ in. in length at the end of this hole. Fig. 32 shows the hollow chamber at *B* and also the hole which is to be threaded after the casting is made.

Fig. 34 shows the necessary core print for this pattern, and is placed as shown at *C*, Fig. 33. Only one core print is needed, as the core hole does not extend way through the casting.

No special directions should be necessary for turning this pattern if proper care is taken in turning the fillet at *D*, Fig. 33, and the necessary allowance for shrinkage and finish are made.

The half core box for this pattern is shown in Fig. 34, *A*. This is an isometric drawing and clearly shows the various parts of the core box. *A* and D are the end pieces. *B* is made first from a clear pine block large enough to finish 1⅞ in. long, 2¼ in. wide and 1½ in. thick. The ends of the block must be accurately squared so that with pieces *A* and *C* perfect joints may be formed. The piece *C* had better be made from a stick 2¼ in. long, 1½ in. wide and ¼ in. thick. The grain of this piece will then be at right angles to the centre line of the core box and there will be no danger of the block splitting when it is nailed to *B*. This piece is cut to the outline of the hollow chamber *B*, Fig. 32, and therefore all surfaces must be made absolutely smooth and especial care taken in finishing the core box so that no core sand will adhere to this part of the core box when the cores are made. Both *B* and *C* of the core box should be carefully tested before being glued up.

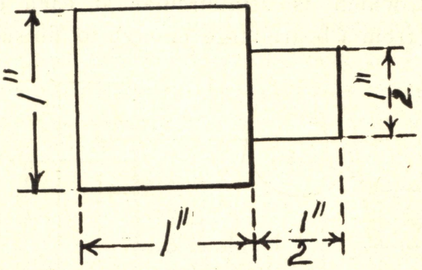


Fig. 34. Core Print for Plunger.

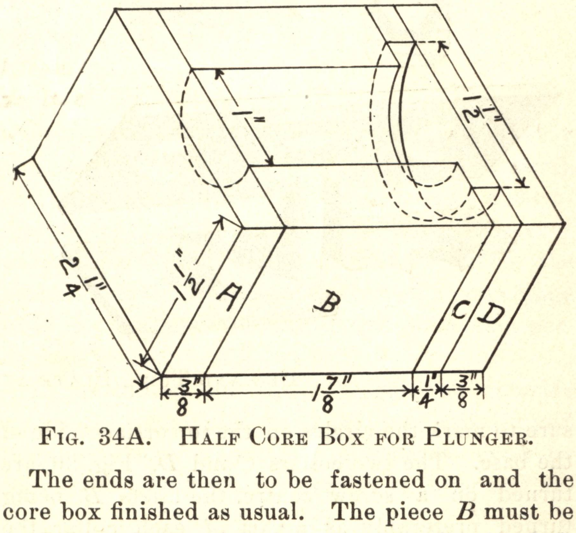


Fig. 34A. Half Core Box for Plunger.

The ends are then to be fastened on and the core box finished as usual. The piece *B* must be made exactly the right length, otherwise the hollow chamber will not come at the required place in the casting.

SMALL ENGINE CRANK.

Fig. 35 shows the casting for a small engine crank, the pattern being shown in Fig. 36. The base *A*, which is semicircular at each end, is shaped from a board large enough to finish ½ in. thick and 2¼ in. diameter at one end and tapering with a straight taper to the other end, which is 1⅜ in. diameter. Do not finish quite to the lines until the collars have been fastened on, and be sure to mark the circles on the top or face side of the base. The two collars *C* and *D*, Fig. 36, are turned on a screw centre, the fillets *B* being turned preferably as a part of each collar, the necessary draft allowances being made at this time. The holes to receive the bottom core prints should be turned or bored out before the collars are removed from the lathe, care being taken not to strike the screw. The collar *C* is so thin that it may be found necessary to cut in with the sharpened end of the tang of a file in order not to cut into the screw. The collars are to be glued and nailed to the base, after which the fillet on the outside half of each collar is to be removed carefully with a sharp chisel, care being

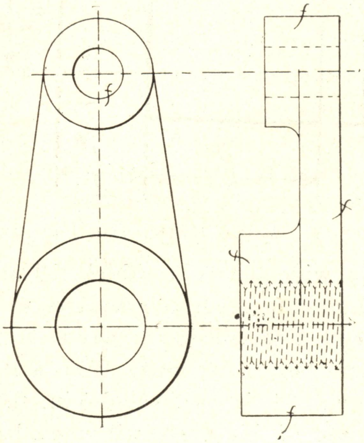


Fig. 35. Small Engine Crank.

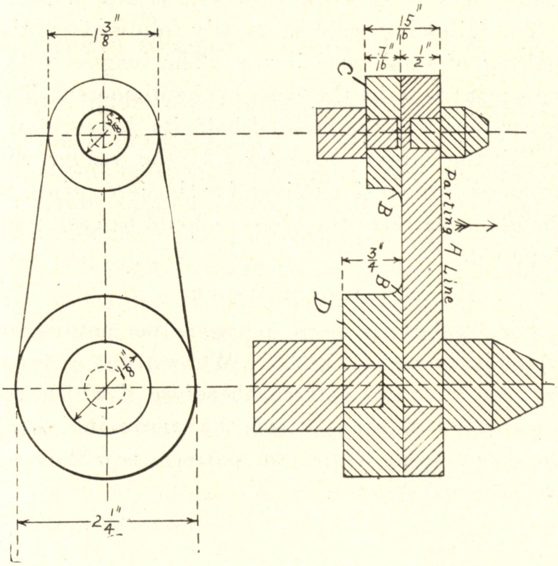
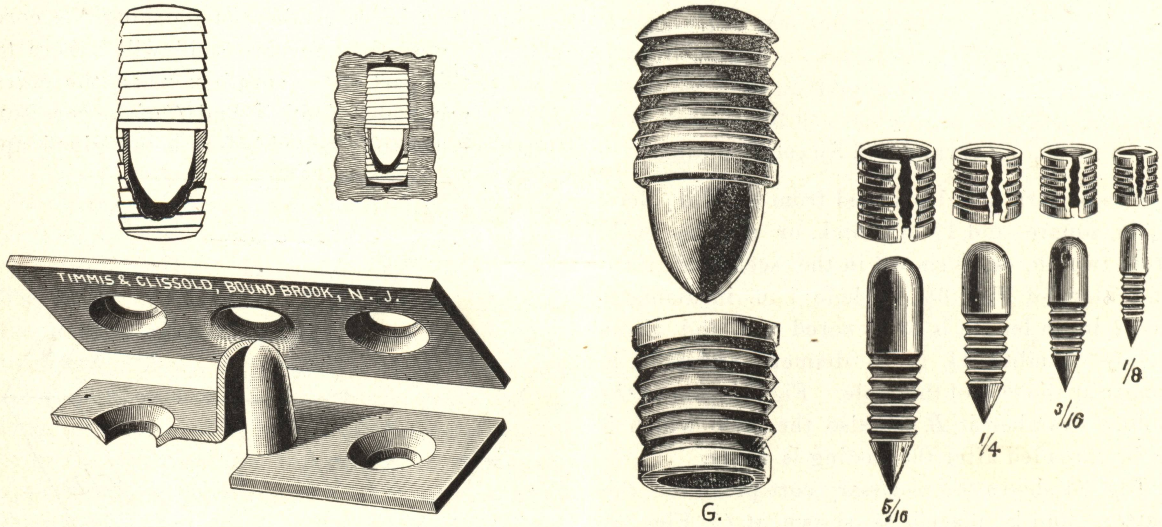


Fig. 36. Pattern for Engine Crank.


TIMMIS & CLISSOLD, BOUND BROOK, N. J.
G.
5/16
1/4
3/16
1/8

Peg and Tube, Plate and Shoulder Brass Dowels.

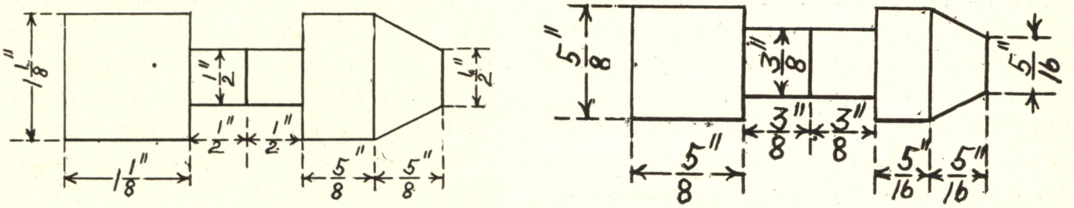
taken not to work against the grain. The edges of the base should now be worked down to the line, making a straight taper sufficient for draft, the parting line between cope and nowell coming at the top surface of the base.

The centre marks, which were made upon the top or face side of the base, are the centres of the holes which are to be bored to receive the ends of the core prints, which must and will come directly over the bottom core prints if directions given here have been carefully followed. The top and bottom parts of the core prints should be glued at the same time and clamped tightly in place with an iron clamp or in a vise. The two core prints are shown in Fig. 37 and are turned from pieces of clear dry pine of a size sufficient to easily finish to the required dimensions.

Half core boxes are to be used, care being taken that the half circles are exactly the right size. As these are to be made in the same manner as the core box for the gland previously described, no further directions should be necessary.

The surfaces requiring finish are marked "*f*" as in previous patterns, and the necessary allowance for finish and for shrinkage and draft should be figured out before the pattern is commenced.

In the next article I shall describe the making of split patterns. These split patterns are, of course, dowelled, wood dowels being used for ordinary small patterns. Brass dowels are unquestionably far superior to wood dowels and are much used for fine accurate work, their superiority lying in the fact that they are always perfect fitting and interchangeable. The brass dowels can be bought from $\frac{1}{8}$ in. up to $\frac{5}{16}$ in. in diameter. For large work brass plate dowels are very largely used, running from 2 in. to $2\frac{1}{2}$ in. in diameter. Through the courtesy of the Winkley Co., Hartford, Conn., and Timmens & Chissold, Bound Brook, N. J., I am able to show you the accompanying illustrations of peg and tube brass dowels, plate brass dowels and shoulder brass dowels.



FIGS. 37 AND 37A. CORE PRINTS FOR ENGINE CRANK.

PHOTOGRAPHY.

PRINTING IN PLATINUM.

W. M'ARTHUR.

It is not an easy matter to convince the beginner in photography that the simplest of all printing processes, and probably the most economical, is the platinotype. There is a strong attraction to P. O. P. for the average worker of little experience in watching the fascinating growth of the image. It appears to be such a simple matter to remove the print when the exposure is complete and to pass it through the various solutions.

All this is perfectly true, and given a fair negative, paper which has not been imperfectly stored, toning baths ,which have been properly compounded, and absolute cleanliness in a chemical sense, there is no obvious reason why every print should not be successful. Yet even the most successful workers reckon upon a percentage of failures, and in the case of beginners the percentage is usually a high one.

In the toning and fixing of gelatino chloride prints, the principles involved are complex and have not been thoroughly elucidated even by those who have brought great knowledge and experience to bear upon the subject. There is, therefore, the less reason for wonder that the photographer working only by empirical rules laid down for his guidance and by the light of nature should make occasional mistakes.

In the case of the platinotype process the problems are simpler, and although the salts with which the paper is coated are easily susceptible to injury and require great skill in their manipulation and preparation, all this does not affect the photographer, who has only to deal with the paper after its manufacture. The paper is coated with a compound of iron and platinum salts, of which the iron alone is sensitive to light, giving an image of a greyish brown tint.

When the exposed print is floated upon or immersed in a solution of potassium oxalate the iron salt is dissolved, and at the same moment the platinum salt, which is in intimate contact with the iron is, in those parts where the light has acted, reduced to the black or metallic stage, and is held permanently in position, being imbedded in the fibre of the paper. The amount of platinum deposited and, in consequence, the degree of blackness in the image, is regulated by the exposure given.

In the high lights, where the paper is protected by the denser parts of the negative, the action upon the iron is very slight, and the amount of platinum deposited is so small as scarcely to tinge the white paper, while in the shadows the amount deposited may be so great as to become solid black. The finely divided metallic platinum being soluble only in *aqua regia* (a mixture of nitric and hydrochloric acid) and not at all affected by climatic influences, the image is absolutely permanent, as it can be destroyed only by means which at the same time cause the destruction of the paper. Properly speaking, no fixing bath is required, development and fixation taking place simultaneously; but a clearing bath of dilute acid is necessary to remove the remains of the iron from the paper, and until this is done the paper must not be placed in plain water.

As the paper is easily damaged by moisture—the touch of a damp finger tip would ruin it—it is desirable that the beginner should purchase it in cut sizes. At the same time he should purchase what is known as a calcium-chloride storage tube. This is a canister having a false bottom of perforated metal, between which and the true bottom a piece of asbestos saturated with calcium chloride solution and dried, is stored. Calcium-chloride greedily absorbs moisture, and in doing so keeps the paper absolutely dry. The joints of the lid and the bottom are damp-proof, either by rings of india-rubber fitted to the joints in some patterns, or applied in the form of rubber bands outside the joints in others. A very efficient storage tube can be had in the "new" pattern for small sizes at a lower price.

On examining the tin in which the paper is sent out it will be seen that the cover is securely sealed by the label. On cutting this and removing the cover the true lid is disclosed underneath and this latter is soldered down, preserving the paper perfectly for a very long time. A cutter will be found inside the cover, and by sliding this as far as it will go, replacing the cover on the tube and turning it round with a little pressure, the true lid is cut out. The ragged edges left after cutting should be smoothed down level with the inside of the tube and the roll of cut sheets enclosed in their wrappers drawn out and transerred to the storage tube—together with a supply of calcium-chloride.

The paper is as sensitive to damp as to light, and if the cover of the tube were not sealed with rubber bands there would be a strong possibility of the paper being spoiled within a very few hours. Properly stored the paper will keep in good condition for many months, but if the tube is repeatedly opened, the calcium-chloride should be occasionally examined, and if it is at all damp it should be removed from the outer wrapper and dried. This may be done by putting it upon a piece of thin iron and placing it on the fire till all moisture has been driven off. Unless the rubber bands fit closely there is always a risk of moisture creeping into the tube.

The preparations for printing are very similar to those adopted in printing upon any other photographic paper, except that additional precautions should be taken against damp. It is well to make a point of drying the printing frames—if they have been used in bad weather—by storing them for some hours in a warm dry room, or, if they are wanted in a hurry, by drying them near the kitchen fire. Care must be taken not to overheat them or they may warp and so cause the negatives to break. The negatives should be dried face upwards over the gas flame or in front of a fire till they are warm to the touch and till the moisture which collects on the glass side has been driven off. Sheets of thin india-rubber are sold as excluders of damp from the printing frames and are most useful, but these also should be dried before use. Spoiled celluloid film negatives from the negatives from which the gelatine has been cleaned off serve the same purpose. It is desirable that all negatives used in platinotype printing should be coated with waterproof varnish; not that there is the same risk of them becoming stained as when printing on P. O. P., but because gelatin absorbs moisture, and paper which is printed in contact with damp negatives will have a tendency to give muddy prints.

The hinged back of the printing frame having been removed and the negatives fitted in, film side upwards, the blinds in the room should be drawn, or the operation conducted at some distance from the window, as the paper is distinctly more sensitive to light than is P. O. P. The tube is then opened and one sheet of paper taken out. It will be noticed that the face side is a bright yellow, the back being white. The paper is then laid with the yellow side in contact with the film or face side of the negative and the back of the frame replaced and fastened down. The storage tube should be closed at once and the rubber bands replaced.

Practically the only thing to be learned in platinotype printing is the depth to which the image should be carried, but as the image is fainter in tint than that on a piece of print-out silver paper, and in a color to which the beginner is unaccustomed, a few trials will have to be made before a correct judgment can be formed. To acquire this power of judgment speedily and economically it is a good plan to cut one sheet of paper into four strips and to print these one at a time. While one strip is being printed the others should be kept in the storage tube.

The printing frame should be placed in a good light, though not in direct sunlight, for the more quickly the prints are made the less risk is there of the paper becoming damp. With a negative of good color and reasonable density printing takes place very quickly. In a few minutes the frame should be taken indoors and one-half of the back opened to permit the print to be examined. The image, as previously stated, is of a grayish brown tint on a yellow ground, and all detail that is to appear in the finished print should be visible, though faintly, after exposure. If the exposure is judged to be sufficient the strip may be cut in half, one part developed and the other kept in the storage tube as a guide when printing the other strips.—*Photography*, *London.*

CONCLUDED IN SEPTEMBER.

REMOVING FILMS.

A. Sodium fluoride, 6 gr; water, 4 oz. *B*. Sulphuric acid, 6 drops; water, 1 oz. Both solutions can be used until exhausted. Place the negative in *A* for a couple of minutes, then place directly in *B*; after another couple of minutes touch the film with finger from one corner. It will soon leave the glass.

Very good also, in the case of a broken negative, for transferring the film on to another glass. In this case, place—before stripping—in 5 per cent chrome alum solution for half an hour. Wash well and proceed to strip.

FOCUSSING CLOTH.

Any one who has wrestled with the orthodox focussing cloth in a high wind, will agree that it cannot be regarded as an ideal method of securing a well illuminated image on the focussing screen. In bright weather, too, when a strong light is reflected from the surface of the ground, and comes streaming in at every aperture left by the cloth, it is equally difficult to determine the value of the lighting of the subject upon the ground glass. To obviate these troubles the writer has had in use for many years a bag arrangement made from a remnant of black velvet. One end has a piece of elastic band sewn in so that it will just slip over the back of the camera and remain taut. The other end is of such dimensions as to allow of its being slipped over the operator's head. By this means all extraneous light is blocked out, and the image appears with unusual brilliance upon the screen, enabling the worker to more accurately gauge the requisite exposure. It also permits of the image being seen distinctly all over the plate when the lens is stopped down, and a better judgment is possible as to the stop suitable in each instance. In interiors, where the light is poor, it is indispensable, and no one who adopts it will ever return to the old methods.—*Photographic News.*

"What is worth doing, is worth doing well."

AMATEUR WORK

77 KILBY ST., BOSTON

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AUGUST, 1904.

Model making, as a means of acquiring experience along mechanical and engineering lines, possesses much greater value than those who have not investigated its possibilities are aware. From model steam engines, dynamos and motors much can be learned regarding their operation, which is of direct practical value when applied to the operation of larger machines. Recognizing this great practical value to readers of this magazine, it is our desire to present descriptions of such machines as would be interesting and valuable, and we would, therefore, be pleased to receive descriptions, together with suitable illustrations, showing what our readers are doing in this line.

Do not forget our special book offer announced in the July issue. To any one sending us $1.25 we will send Amateur Work for one year and a copy of either Norrie's "Induction Coils" or Avery's "A B C of Dynamo Design." The first is a book of value to those interested in coil construction, and the second gives much valuable and useful information for builders of small dynamos or motors.

Attention is called to our new department, "Handy Hints for Amateurs." Contributions to this department are solicited that it may be made of as much practical value as possible.

Those who have recording to do or writing of articles for publication will be interested in the following table of abbreviations, which is sent out by a committee appointed by the American Institute of Engineers:

Name	Abbreviation.
Inches	in.
Yards	yd.
Miles	spell out.
Pounds	lb.
Grains	gr.
Tons	spell out
Gallons	gal.
Metres	m.
Millimetres	mm.
Centimetres	cm.
Kilometres	km.
Kilogrammes	kg.
Grammes	g.
Milligrammes	mg.
Kilogramme-metres	kg-m.
Metre-kilogrammes	m-kg.
Seconds	sec.
Minutes	min.
Hours	hr.
Linear	Lin.
Square	sq.
Cubic	cu.
Per	spell out
Fahrenheit	Fahr. or °F.
Centigrade	cent. or °C.
Percentage	per cent.
Volts	spell out.
Ohms	spell out.
Watts	spell out.
Kilowatts	kw,
Kilowatt-hours	kw-hr.
Amperes	spell out.
Brake horse power	b. h. p.
Electric horse power	e. h. p.
Indicated horse power	i. h. p.
British thermal units	B. t. u.
Gramme-calorics	g-cal.
Kilogramme calorics	kg-cal.
Magnetomotive force	m.m.f.
Electromotive force	e.m.f.
Revolution per minute	rev. per min.
Circular mils	cir. mils.
Miles per hour per second	miles per hr. per sec.
Candle-power	c. p.
Watts per candle-power	watts per cp.
Mean effective pressure	spell out.
High pressure cylinder	spell out.
Diameter	spell out.

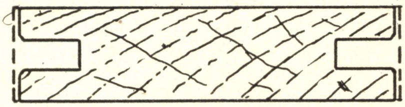
JOINTS IN WOOD-WORKING.

FRANCIS L. BAIN.

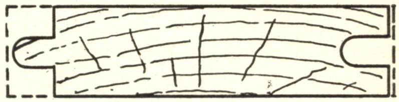
II. The Matched Joint.

Having given proper consideration to the extensively used glue or butt joint, we will next give our attention to the splined or keyed joint; also the matched or groove and tongue joint. Of the two named the splined is more desirable, everything considered, particularly because there is no unnecessary waste of material, as with the groove and tongue. For example, suppose it is desired to join several pieces of some valuable wood together with as little waste as possible and it is necessary that each piece (only 3¼ in. wide in the rough) shall finish 3 in. wide when glued up. By referring to the illustration it can be seen that *A* (the splined) could easily be made to conform to the specified measurements, while *B* (the groove and tongue) would need so much more extra width from which to form the tongue on one edge, that it would be impossible to joint up the stock properly and tongue it and retain the specified width. Aside from the reason just given, it is a well known fact among cabinet-makers and woodworkers in general, that a tongue or spline formed of a separate piece of wood is much stronger than a tongue formed on the edge of one of the pieces to be joined together.

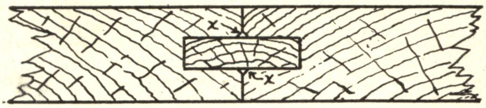
The relative value of these joints being apparent, we will take up the construction of the splined joint, first calling attention to one rule which always governs the making of a splined mortise and tenon, or groove and tongued joint, namely:—The key, spline, tenon or tongue, as the case may be, should always be just one-third of the thickness of the stock of which it forms a part. Hence, having prepared the various pieces exactly as if making a butt joint, a groove should be made in all joint edges which shall be twice as deep as it is wide, then the outer corners of each groove should be rebated or lightly planed off, as illustrated at *C*, to allow an easier entrance for the spline and to preclude any possibility of an imperfect joint from raised edges. Then the splines should be carefully planed up, preferably from a harder wood, so they will just fit in the groove snugly, without any looseness or play. When properly fitted apply a thorough coating of thin glue to both grooves, also to the joint edges, then fit the spline carefully into one groove, place the piece of stock in a vise, spline uppermost, and



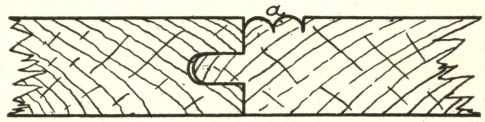
A-Showing 3" exposure after jointing and grooving stock only 3¼" wide in the rough.



B-Showing impossibility of obtaining 3" exposure under same conditions as above.



C-Splined joint rebating at x.



D-Matched joint masking at a.

placing the second piece of stock over the spline, groove downward, carefully face the pieces together, applying cabinet-makers' clamps after the united pieces have been properly aligned. When making this, as well as other joints, be careful to avoid the mistake so common to a great many workmen, sandpapering surfaces which are to be glued together, as satisfactory results are never accomplished in this way.

The groove and tongue joint are made similar, in some ways, to the splined joint. A plow plane is used for grooving the board for the latter, while matching planes should be used for the former. After the matching has been properly done a bead is often moulded on the face side of the stock, just behind the tongue, to mask the joint, as shown at *D*. The glueing process is practically the same as with the splined joint, except that the tongue is fixed instead of moveable.

If very many pieces of stock are to be joined together by either method, it is advisable to cleat across one side or the other in order to prevent buckling of the various pieces, which is sure to occur if they are subject to any weight or pressure, unless they are properly backed up or secured in some other way.

TOOL MAKING FOR AMATEURS.

ROBERT GIBSON GRISWOLD.

I. Kinds of Steel, — Forge for Tool Making, — Set of Useful Punches.

The art of tool making is one most valuable to the amateur worker, and should be practised whenever the opportunity presents. There are many special tools needed by the amateur that cannot be obtained in stores, and to have them made would entail quite an expense. Those that can be obtained are often very expensive and sometimes of inferior grade.

As to the selection of the steel, this is best determined by the use to which the tool is to be put. For instance, it would be a waste to use a high-priced steel such as Musket, Novo or Jessops for tools like centre punches, while for small, delicate tools whose use requires great care and delicacy of touch, the very best grades of tool steel should be used, as they last indefinitely.

Of the many grades of tool steel, the ordinary rolled bar will do for the heavy tools, but for lathe tools the better grades should be used. These are generally of such composition as to require a special treatment other than the simple water hardening process. The treatment of each steel will be taken up as its use is spoken of later on.

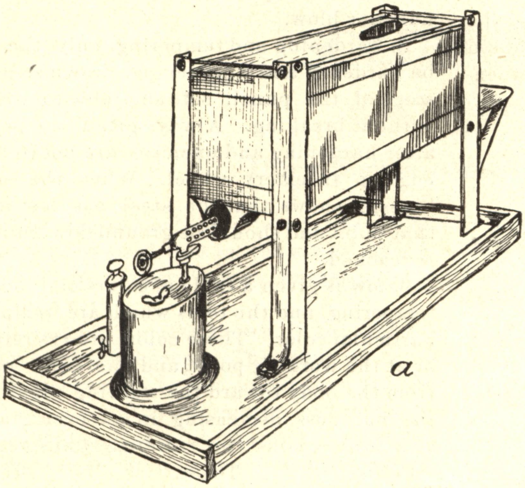
The ordinary tool steel, commonly spoken of as a high carbon steel, is best for making special shaped tools, as it submits readily to forging and can be readily worked with a file to shape before hardening and tempering. Under this head would come special forming lathe tools, dies, punches, etc. Whenever it is necessary to work the tool to shape by filing or turning, a steel of this class must be used, as grinding is the only operation that some of the special steels will submit to other than hammering while hot.

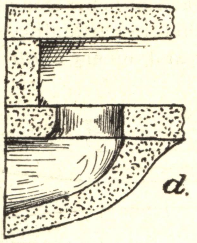
In the case of ordinary lathe tools, which are forged to shape and finished on an emery wheel, any of the special steels may be used, many of them being self-hardening, or air-hardening. These tools must not be hardened in water, as they will not stand it, generally cracking off completely, or else so far that the first touch breaks off the edge.

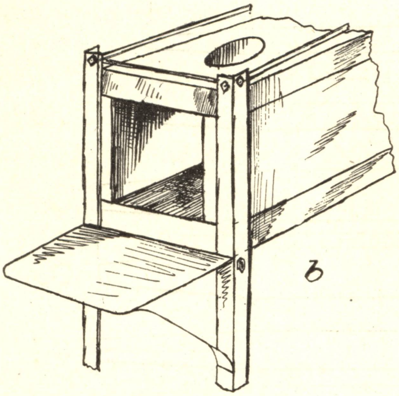
As a necessary requisite in tool making is a good heating furnace. this will be described first. In it all operations for forging, hardening or tempering may be easily performed. A coal fire is sometimes useful, and perhaps necessary for large pieces, but as the amateur rarely has such large tools to make, the gas forge here illustrated is far more cleanly, convenient and quicker. Its greatest advantage is the control feature. It may be made as hot as necessary, or just a low red heat may be maintained for a long period. It is free from disagreeable odors and noxious fumes, and the work may be seen at all times, which is practically impossible in a coal fire.

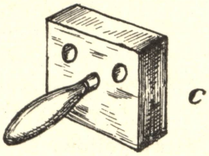
The illustration, Fig. 1, shows the furnace complete. The heater is an ordinary gasolene torch, such as is used by electrical repairmen and painters. The entire outfit should stand in a hollow tray of wood lined with asbestos paper ⅛ in. thick, both on the bottom and sides.

The oven of the forge is made of fire-brick 1½ in. thick. The bottom and top bricks are each 7x12½x1½ in.; the two sides 3x12x1½ in. and the ends 3x4x1½ in. One of the end bricks is trimmed to fit the end of the furnace oven and act as a door. The four uprights or corner pieces are made of ¾x¾ in. angle iron, which also serves for legs. One end, lower, of each leg is split and a foot turned over to serve as a lug to screw to the base. The other side of the split end is cut off. Through holes drilled in the angles, ¼ in. rods, threaded at the ends and provided with nuts, pass and support the oven, as well as bind the bricks together. The top brick has a 2 in. hole cut in it near the front for the escape of the gases, while the lower brick has a similar hole at the rear for the entrance of the flame. This hole is covered by a pipe made of fire clay and baked, the section of which is shown at Fig. 1, *d*. A few holes or grooves may be cut in the under side of the brick, which will serve to give a hold for the plastic clay before this pipe is baked on.









A small sheet iron shelf or hearth is fastened to the front as shown at *b*. The small door brick,*c*, is provided with a loose wooden handle which is inserted in a hole in the brick, an iron pin 2 in. in diameter having been driven into the handle for this purpose. Two peep holes are also bored in this cover through which the progress of heating may be observed. This door should fit loosely so that it will not bind when heated. Fire-brick can be readily cut with an old saw, and holes may be drilled with an old iron file fastened at one end, hardened and ground like a flat drill; this drill can be held in a bit brace.

Some small pieces of fire-brick should now be cut, upon which tools may be rested while heating, say 2½x 1x1 in., and a few 2½x1x1½ in. These serve to hold the work off the floor so that it can be heated evenly all around. When a high temperature is required for forging, the piece may be placed over the hole in the rear where the flame will strike it direct.

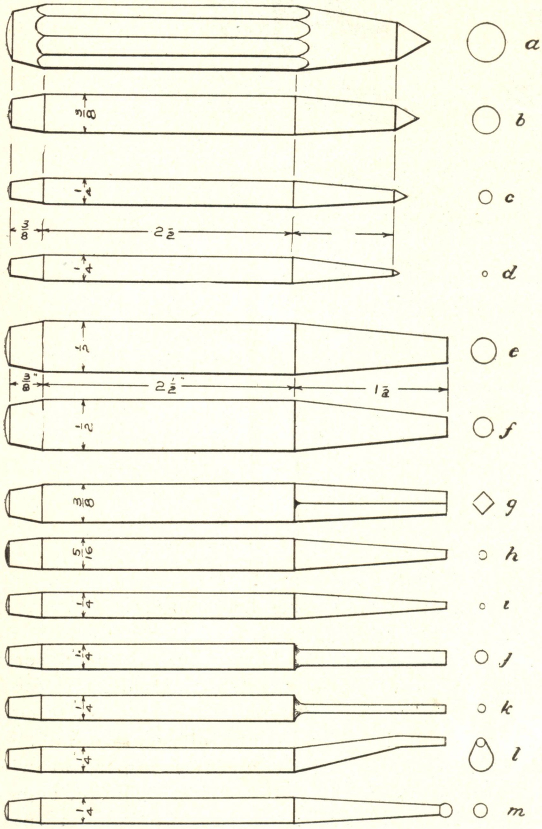
An anvil should be provided nearby upon which the hammering can be done. While a heavy block of steel, mounted on a post planted n the ground, forms a fair anvil, it is better to make a pattern of wood and have it cast in iron, if steel cannot be had. The foundry will chill the face if asked. A good hammer and two pairs of tongs will be sufficient at first. A bucket of water should stand beside the furnace, as well as a small bucket of brine (salt water) and a can of fish oil for use in tempering.

Since the ordinary carbon steel presents less difficulty in working than the other varieties, we will consider its use first. In heating any steel, be careful not to over heat it, which is easily done. For forging, only a bright red heat is necessary for small tools. Too high a temperature burns the steel, and no subsequent treatment will repair the damage.

A good preliminary lot to work on will be a set of centre punches. These punches are almost constantly in use and should be well made. It seems to be a common opinion that almost any piece of round steel ground to a point will do for a centre punch, but with careful workers such is not the case. The set should comprise the following:— A heavy punch for solid, hard pieces, and in starting a large drill; it should be at least ⅝ in. diameter, with a conical point about ⅜ in. diameter at the base, as shown in *a*, Fig. 2; punches *b* and *c*, which are used for lighter work, and punch *d*, which is used only in laying off work. Accurate work cannot readily be laid off with a thick punch, owing to its hiding the intersections of the lines.

Many punches are turned from the rod and hardened without any forging, but the more work put into the steel at the working point the better will be its grade. Its grain will be finer and the working edge will stand up in service far better.

After the punch is forged to shape, heat the point to a dull red and instantly plunge the point *only* into the brine bath, immersing it about ½ in. When cold, or at least black, rub a bright spot thereon with a piece of emery cloth tacked to a flat stick, and then hold in the light until the heat in the stock of the punch begins to color the bright spot a straw yellow. At this point plunge the entire punch into the water and move it about until cool. Should the heat remaining in the punch be insufficient, lay the *body* of the punch over the top hole of the furnace and draw the color to that mentioned above. It must be remembered, however, that all work on each punch, except grinding the point, must be done before hardening, so each should be finished with file and emery cloth before hardening.



It is upon the property possessed by steel of taking on certain colors at different temperatures that tempering depends. A steel may be made extremely hard in water, but it would be so brittle that the first blow would crack the point off completely. Upon reheating the hardened piece to a definite temperature, indicated by its color, this hardness is reduced and the tool is thus graded in its degree of hardness to suit the work upon which it is to be used. A list is given below showing the various colors and corresponding temperatures that are used in tempering various tools.

In Fig. 2 is also shown a set of punches very useful in general work. Punches *e*, *f*, *n* and *i* are for starting or driving pins, bolts, etc.; *g* is a square end punch often found useful in corners and in special work. Punches *j* and *k* are for driving pins through holes where a taper end punch would get stuck; *l* is an off-set punch often used when it is impossible to reach with a straight one, and *m* is very handy in bending the end of a pin so as to make it hold, similar to riveting. Hammers often bruise the work, especially in close quarters. The head should always be kept slightly round, which prevents "brooming" and lessens the liability of an injured hand from a glancing hammer blow.

In hardening and tempering, only the points should be hardened and the temper drawn so as to leave the stock of the punch soft and able to withstand blows without breaking. Always grind the points to shape after hardening and exercise care not to burn the thin edge on an emery wheel. When the edge of a tool blues, it shows that the steel has lost its hardness at that point and should be ground down until hard metal is reached.

Below is given a table of colors and temperatures for tempering, and the tools which are tempered at each particular color. These colors always refer to the color at the working point, and the color must "crawl" from the body toward the working edge. This insures the hardness decreasing in an even gradation.

TABLE OF COLORS AND TEMPERATURES FOR TEMPERING.

Color.	Temp.	Tools.
Very pale yellow	430° F.	Scrapers for brass, steel-engraving tools, slight turning tools, hammer faces, planer tools for steel and iron, ivory and bone cutting tools, wood engraving tools.
Straw yellow.	460° F.	Milling cutters. wire drawing dies, boring cutters, screw cutting dies, taps, punches and dies, pen knives, reamers, haif round bits and chasers.
Brown yellow.	500° F.	Stone cutting tools, gouges, hand-plane irons, twist-drills, flat drills for brass, wood boring cutters, drifts.
Light purple.	530° F.	Edging cutters, augers, dental and surgical instruments, cold chisels for steel.
Dark purple.	550° F.	Axes, gimlets, cold chisels for cast iron, saws for bone and ivory, needles, firmer chisels, cold chisels for wrought iron, hack saws, framing chisels, circular saws for metal, screw-drivers, springs, saws for wood.
Dark blue.	570° F.	
Pale " "	610° F.	
Blue, tinged green.	630° F.	

A few don'ts for forging, hardening and tempering.

Don't hurry.

Don't strike too hard.

Don't overheat the steel.

Don't heat the steel too quickly. This heats the outside and not the centre.

Don't hammer hard when the heat falls below dull red. Use light taps then in finishing.

Don't allow the red hot steel to "soak" in the furnace.

Don't use two heats where one will do.

Don't harden the tool where it is not needed.

Don't have tools too hard. It is easier to resharpen a dull tool than to reforge a broken one.

Don't hold the tool still in the bath. Move it constantly, except where hardening only the point.

Don't forge too thin an edge on a tool. Make the cutting edge on a grindstone or emery wheel.

The following article will treat of lathe tools.

SOLDERING.

H. M. CHADWICK.

II. Using Bunsen Burner and Blow Pipe.

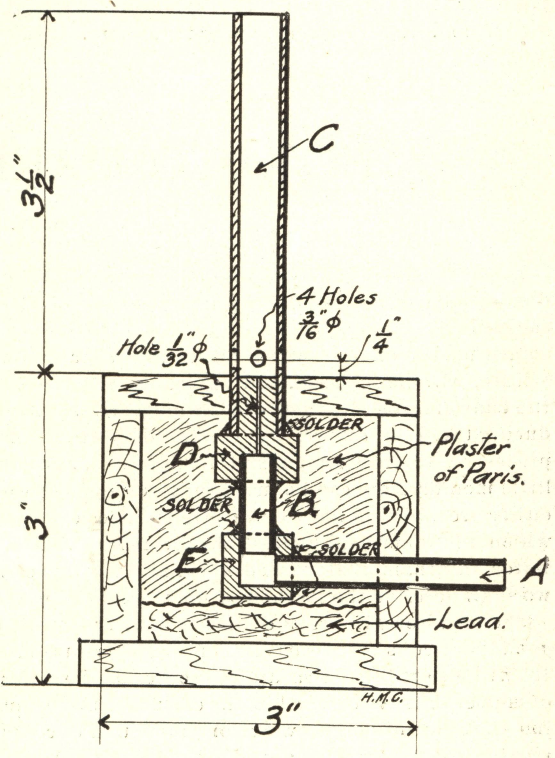
The Bunsen burner and the blow pipe are needed by one who would become proficient in the art of soldering. A cheap and satisfactory Bunsen burner may be constructed as follows:

Make a small box of the size shown in the sketch and fit it with a hard wood cover. This kind of wood is burned much less readily by hot solder than pine or whitewood. Pour a quantity of molten lead into the bottom of the box, being careful that the lead is not heated much above the melting point, as it will burn the wood if too hot. A handful of shot or iron filings may be used in place of the lead, the object being to weight the burner so that it cannot be easily overturned. *A* and *B* are pieces of umbrella tube, *C* is a piece of iron or brass pipe about ½ in. outside diameter, *D* and *E* are pieces of brass or iron, and are drilled to admit tubes *A* and *B*. Brass should be chosen by anyone not having a lathe, as it can be drilled with a twist drill, held in a bitstock. The position of *D*, which enters the pipe, *C*, should be turned or filed to a good fit. The small hole in *D* is about 1-32 in. diameter, and should be central with the pipe, *C*. Drill four 3-16 in. holes in pipe *C*, near the bottom, for the admission of air.

Solder all joints as noted in the sketch. This can be readily done with the soldering iron, carrying out the directions of the first article in AMATEUR WORK for July.

Bore a hole in the side of the box to admit pipe *A*, and also one in the cover to fit closely around *C*. Mix enough plaster of Paris to fill the box, and pack it tightly around the base of the burner. Scrape it off flush on top and nail down the cover. The Bunsen burner is to be connected to an ordinary gas-burner with a piece of rubber hose. The blow-pipe is a necessary tool to be used in connection with the Bunsen burner. It is well to buy this article, as the manufactured ones are lighter and better than any that the amateur can make.

To produce a blast flame, put the large end of the blow-pipe in the mouth and turn it so that the small orifice points horizontally, quite close to the Bunsen flame and at a point about two-thirds of the distance from the base to the peak. Blow steadily, using the mouth as an air reservoir. After a little practice it will be found that air can be taken into the mouth with the tongue independently of the act of breathing, and that a steady stream of air can be forced from the blowpipe.



BUNSEN BURNER.
SECTIONAL ELEVATION.

The flame thus produced will be seen to consist of two portions, one within the other. The inner is called the reducing flame. It is the hotter of the two and is the one which should be applied to the article to be heated. The outer is called the oxidizing flame ; it will change to an oxide any piece of metal placed in it. The application of the reducing flame to metallic oxides will free the oxygen, leaving the metal with which it has combined.

The flame of the Bunsen burner is of the same nature as the blast flame, but it is not so hot and powerful, since the air mixture is caused by the natural draft through the holes in the base of the burner.

Suppose we wish to solder together two small washers in order to get one of double thickness. In this case the blowpipe will not be needed. Clean each piece carefully and brush on one side with flux. Cut a small piece of solder from the stick, place it on one of the washers and hold this in the Bunsen flame with a pair of pliers. The solder will melt and run all over the washer in a thin film. If too much solder has been used, brush off the surplus before it can harden.

Now hold the two washers with the trimmed sides in contact, in the flame, pressing them together with pliers or hand vise until the solder is thoroughly melted and the surfaces appear to adhere. Remove them from the burner, keeping up the pressure on the pliers until the solder has set. Clean the bits of solder from the edges with a file or scraper. If the job has been well done only a thin, silver line will mark the joint.

Pieces to be soldered together that cannot be held with pliers or hand vise should, if possible, be wired into position, or, if wiring is impracticable, press them into a mass of adhesive substance made of plaster of Paris and clean sand mixed half and half with water, of course leaving exposed the parts to be soldered. Sometimes putty will answer this purpose. Again, certain articles may be held by nailing them to an asbestos covered wooden block or piece of pumice stone. Whatever method is used, all contact surfaces of any size should be thoroughly tinned before fastening.

It is convenient to have the burner connected to the gas supply by a long hose so that it can be held in the left hand and moved to any convenient angle, while the blowpipe and blast flame are directed with the right. The flux may be removed from soldered articles by boiling them a few minutes in weak sulphuric acid.

To use the blast flame successfully only requires practice as the solder follows a clean joint very readily.

HOW TO MAKE ELECTROTYPES.

S. R. BOTTONE.

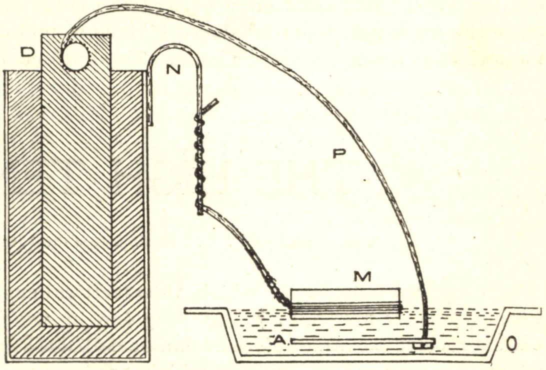
The enthusiastic amateur who has succeeded in producing some of the beautifully artistic work of which the lathe is capable, or who has in his possession a coin or medallion from which he requires to take a duplicate, will be pleased, and agreeably surprised, by the charming results that can be obtained by reproducing these in *copper*, by electro deposition. The process is at once simple and inexpensive, and by a little modification can be used to give reproductions either precisely similar to the original ones or ones in which the reliefs and depressions are reversd. As the latter, in ornamental turned work, are very effective, we shall describe the method of obtaining these first.

The operator will provide himself with two or three good " dry cells ". A convenient size measures 6x2″. He will also require a saturated solution of sulphate of copper (blue vitriol), which he can make up by pouring one quart of boiling water on one pound of copper, stirring frequently with a stick or glass rod until cold. The solution should be made up in a glazed earthern vessel. When quite cold about one and a half fluid ounces of oil of vitriol should be added to the blue fluid, in a fine stream, with constant stirring. The addition of the oil of vitriol will cause the solution to get hot. It must be allowed to cool, when it may be placed in a stoppered bottle ready for use. Several discs of thin sheet copper (about 1-16″ thick) of varying diameters, according to the size of the work to be reproduced, will also be needed, and to the edge of these (which are called " anodes") is to be attached a wire by drilling a hole near the edge of each disc and inserting therein one end of a 10″ length of No. 16 copper wire and burring it over the plate by hammering. This makes good contact wtthout soldering, which is to be avoided. The next requisite is a rather deep, flat-bottomed, circular, well-glazed earthenware dish. A soup-plate will answer very well, unless the objects to be copied are very large, in which case one of the square white earthen dishes used by photographers, wherein to wash their prints, may be used. Two or three yards of No. 18 or No, 20 bare copper wire will also be required for the purpose of connecting up the wooden ornamental turned work to the negative pole of the dry cell.

Being provided with the necessaries, the operator selects the turned work which he desires to reproduce in copper, and brushes over the worked surface with a paste made of good fine plumbago (blacklead) and a little water. The brush made use of must not be so hard as to mark or in any wise deface the delicate tracery of the original; but, on the other hand, it must be sufficiently firm to enable the operator to get up a brilliant, metallic-looking surface like that of a well-polished stove. For convenience of future reference we will call this black-leaded surface " the front " of the mould (technically termed the " cathode "). The purpose of performing this operation is to render the wood, which would not otherwise conduct electricity, conductive on this surface. It must be borne in mind that wherever the blacklead has been applied *there* will the copper be deposited. Hence, to prevent waste of battery power, copper and time, care must be taken not to carry the blackleading too far up the sides of the work. A little way up it must reach, so as to enable a good contact to be made with the wire, which will afterwards serve to connect it to the negative pole of the dry cell. The best way to effect this is to take a strip of paper and roll it tightly round the sides of the work, leaving about ¼'' bare all round near the front of the mould. Holding this tightly in the left hand it will be easy to blacklead and polish the edge as well as the front without encroaching too far up the sides.

When this has been satisfactorily effected, the paper strip, which served as a guard, can be removed. Now, taking a piece of the No. 18 or No. 20 bare copper and gripping one end in the vise, he will wind it two or three times round the blackleaded edge of the work, so as to grip it firmly and make good electrical contact with the blacklead under it. The extremeties of this wire are brought together and twisted tightly, so that the coils may not loosen. The wire should now be cut off at a distance of about 10'' from the work, and bent upwards at right angles to the front of the mould. An anode is now selected, having a diameter as nearly as possible that of the front of the mould. (This wire, so far as it will be immersed in the copper sulphate solution, must be painted over with a little Brunswick black, otherwise it will be eaten through by the solution.) The other end of this wire must then be clamped under the terminal affixed to the carbon (or positive) pole of the dry cell and then bent twice at right angles in such a manner that the anode can lie flat at the bottom of the dish, which must be placed near the dry cell. The dish should now be filled to a height of about 1'' to 1¼'' from the bottom, with the copper sulphate solution prepared as directed. The work to be copied is now attached, by its slinging wire, to the zinc (or negative) pole of the dry cell, and the wire so bent that the front of the mould if immersed in the solution as far as the wire binding extends or, say, for a depth of about ¼". It should lie perfectly horizontal, facing but *not touchlng*, the anode, at a distance of about ¾'' to 1'' from *its* surface. In immersing the mould, care must be taken to avoid air bubbles, and this can be done by letting down the front of the mould, somewhat tilted. so as to allow any air bubbles to escape; the wire can afterwards be straightened to cause it to lie horizontally. Great care must be taken that *good metellic contact* is made between the two wires and their respective dry cell terminals, and also that no contact occurs, either between these two wires on the one hand or between the mould and the anode on the other. After thus connecting up, the front of the mould should be allowed to remain in the solution for about fifteen minutes. It should then be examined in order to judge of the success of the work.

If the binding wire shows that it has received a rosy-pink deposit, beginning to extend to the edge and creeping round to the front of the mould, all is going well—the current is of the right strength; and if the mould be carefully replaced in the solution, the terminal contact being maintained tight and good, it will be found that after ten or twelve hours' immersion the entire surface of the mould will have received a delicate coating of copper. To get a layer 1-16'' thick it may be needful to continue the operation for three or even four days, or even to replace the dry cell by a fresh one, according to the size of the mould. But if on examination, it is found that the surface of the binding wire and of the front of the mould are coated with a ruddy brownish mud, tending to fall to the bottom of the dish, and especially if bubbles of gas form on and round the mould, it is a sign that the current is *too strong*. In this case it will be necessary to remove the anode further away from the front of the work, or even to insert a "resistance" in the shape of a foot or two of No. 36 iron wire between the anode and the carbon terminal of the dry cell. When it is considered that the copper deposited has attained sufficient thickness, the mould should be removed from the sulphate of copper solution, the wire detached from the dry cell and the mould washed for some time in a stream of running water, after which it should be slung up by its wire to dry thoroughly in a warm place. When the work is quite dry the binding wire is untwisted and the wire carefully unwound from round the edge of the work. If the copper deposit is very thick at these points it will be advisable to file it down cautiously all round, so as to avoid breaking away any of the copper deposited on the front. Having thus filed away any copper that may have extended round the edges of the work, the front of the mould should be held for a few seconds before a clear fire so as to warm the copper coating. This will cause it to expand slightly, after which, by cautiously pushing with the fingers from the back of the mould, the copper coating or "electrotype" can be easily detached. It may then be washed and brushed up with a soft nail brush and soap and water; or it may be "bronzed" with blacklead or lacquered, if it is desired to preserve the beautiful surface it pre-



sents when first detached from the mould. The work or mould, if soiled with blacklead, may be cleaned with a soft tooth brush moistened with benzine. It may be necessary after this to brush up with soap and water, using a fresh, clean brush.

When it is desired to produce a facsimile of the article to be copied a trifling modification must be made in the manipulation. This consists essentially in preparing, first, a wax mould or cast from the original, from which mould the copper electrotype is produced. To this end take a strip of paper long enough to make four or five turns round the sides of the object to be copied. This must be bound round the edge so as to extend up above the face of the work to a height of nearly half an inch, and tied tightly round the sides. The whole should now be laid on a flat table face upwards. Sufficient good beeswax to cover the face of the work to a depth of about ⅜″ is now melted in a perfectly clean pipkin or ladle. The surface of the work and the inside of paper binder are now heavily breathed upon so as to prevent the wax adhering, when the melted wax is immediately poured in to a depth, as we have said, of about ⅜″. The mould should now be allowed to stand for an hour or two to set and harden thoroughly. The paper binder is then removed, the wax mould pulled off and three or four turns of No. 20 wire bound round the edge, the surface and the edge of the mould carefully blackleaded with a very soft camel's-hair brush. It will not be advisable to wet the blacklead, but, using fine powder, breathing on the mould will suffice to render the surface sufficiently adhesive to take a good polish. The blackleaded mould is now to be treated precisely as reccmmended for the reversed facsimile. At Fig. 1 is shown sectionally the proper position and connections of dry cell wire to anode, depositing dish, mould and wire from mould to negative pole of cell.

Engineering World, London.

THE HIGH TENSION ENGINEER.

A paper read by T. M. Lincoln before the 13th. convention of the Canadian Electrical Association.

There are two schools in which the electrical engineer may receive his training, but only one in which he must receive a course before he can be called a high tension engineer. Those things which are learned in the schools equipped with professors and laboratories and mathematical text books must be supplemented by the things which can be learned only in the school of experience. These two schools are quite different in method. The college instructs in theory and in those methods of doing things which have become standard by universal adoption. The college teaches positive knowledge. In the school of experience, on the other hand, one is more apt to learn how not to do it, and by the elimination of the unsuccessful, arrive at the goal of success. The knowledge gained by experience is more often negative.

Put to the fresh college graduate the problem of the amount of distance to be left between the conductors of a high tension transmission line. His answer will involve, most likely, the jumping distance of the voltage to be used, the length of span, the sag, and perhaps a liberal factor of safety. It is experience only that will show that his premises are wrong and that the equation to determine spacing of high tension wires depends very little on the voltages to be carried and almost entirely on such little things as the average length and ohmic resistance of cats, the spread of wing of owls and cranes and eagles, and the average length of scrap baling wire, together with the strength of the average small boy's throwing arm.

The college graduate enters prectical work invariably feeling that the great danger of his work lies in his liability of receiving a shock from the high tension conductors. Not until he has had experience with accidents of an electrical nature does he learn that it is the danger of being burned he has to fear more than the danger of shock. My own experience, and I think it will be checked by the large majority of those in a position to know, has been that the number of electrical accidents in which the victim has been injured by burning is incomparably greater than the number from shock.

The graduate has learned how to make accurate measurements of power. He finds after he has "been up against it" that it is easier to measure power accurately than it is to persuade the customer that his power is being accurately measured.

The man fresh from the college laboratory enters his practical duties with the idea that rubber is one of the best insulators that exists. It is not until he has seen rubber insulation break down in the most unaccountable manner that he finds that rubber as a high tension insulator is extremely treacherous. The deterioration of rubber insulation is probably due to chemical reactions on the rubber induced by the brush discharges, which are in turn caused by the high voltage of the conductor.

The newly made graduate usually has a high opinion of efficiency and can calculate the economy of a transmission to an excessively small fraction. When he becomes responsible for the operation of a transmission line, however, it does not take him long to find out that efficiency is a vanishing quantity when compared to continuity of operation, and that economy is not to be considered as being in the same class as good service.

The technical graduate, in short, may have knowledge in plenty, but his wisdom is to come.

It is furthest from my thoughts to cast any slur upon the technical graduate. I look back upon my own course in electrical engineering and feel that it is the most valuable asset I ever possessed. The technical course is the best of foundations, but it is only a foundation. The end of the college course is rightly called "Commencement." The great advantage of the technical education is that it gives the man proper equipment for overcoming the difficulties with which his experience is bound to bring him into contact. It gives him, as nothing else will, the power of initiative —that most valuable quality that a high tension engineer can possess. There is nothing like the college education to equip a man for making every accident a lesson in "how not to do it," and every failure a stepping stone to success.

Take, for instance, the recent accident to the Niagara plant, in which a fire destroyed the cables on the bridge connecting the power house with the transformer house. The lesson to be drawn from this accident—so plain that he who runs may read—is that where many cables are run together, extreme precaution should be taken to protect against danger of fire. Before the occurrence of this fire there was little suspicion that the insulation of cables when lead covered or protected by fire proof braid—as was the case at Niagara—is sufficient to maintain so fierce a blaze without the aid of some other combustible besides the insulation. One accident of this kind should suffice, not only for the Niagara Falls people, but also for any others who have occasion to run many cables together.

The art of long distance transmission as it exists today is the result of the accumulated experience of all those who had to do with transmission work. And the process of accumulation is still going on. Those men who today are designing and operating transmission plants are the moulders of the art. Their expedients for improving service or reliability or for cheapening cost are noted, and when successful have their influence on future installations.

The high tension engineer, no less than the man in any other department of human endeavor, may find in failure the way to better things. It was Roosevelt, the strenuous, who gave utterance to the sentiment that absence of failure accompanied only lack of effort. "The uses of adversity are sweet," and the engineer may well heed the words that Shakespeare puts into the mouth of the Duke, who, exiled to the forest of Arden, finds "tongues in trees, books in running brooks, sermons in stones, and good in everything."

A SENSITIVE GALVANOMETER.

A sensitive and well-made galvanometer may be used for a variety of purposes. Not only may it be used for the testing of resistances, both high and low, but by the use of a proper shunt may be used to measure strong currents, and by the use of a high series resistance may be used to measure the voltage of an electric circuit. An old telephone generator furnishes excellent magnets for the construction of such a galvanometer. A magnet which the writer secured from such a source measures 6 ins. in length and is made of steel, which is ½ in. by ⅝ in. The more powerful the magnet the better will be the results. Its dimensions may vary somewhat from the one used in the following paper, but the reader can easily modify his instrument to suit his needs.

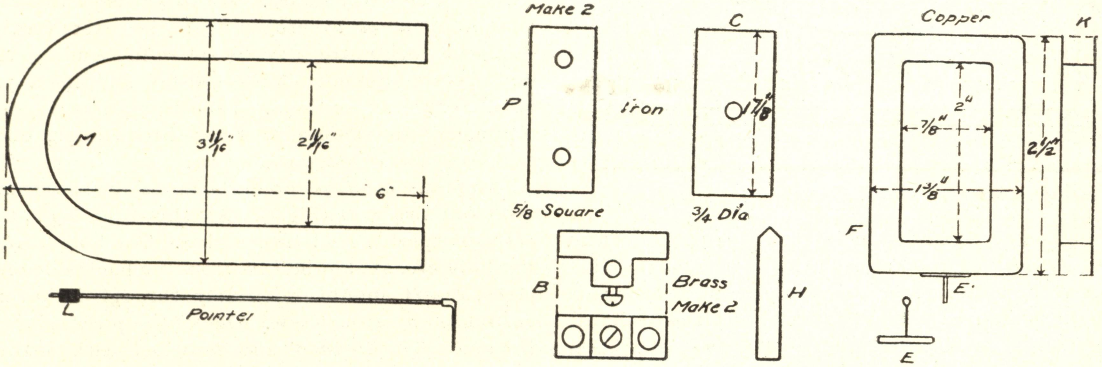


FIG. 1. DETAILS OF GALVANOMETER. (*Not to scale.*)

A bottomless box with a glass top will be required, mounted upon a base board, the whole being suited to be screwed to the wall as shown in Fig. 2. This box is 7 in. by 13 in. outside measurement, and 4½ in. deep. The base board should be 15½ in. by 8½ ins. The box is secured to the base board by two hasps, one on each side, two or three dowel pins helping to hold the box from slipping. This method of securing the box is adopted so that the case may be easily removed, giving access to the working parts of the instruments inside.

The magnet used being ⅝ in. wide, two pieces of iron, shown at *P*, are made for pole pieces. These are ⅝ in. square and 1⅞ in. long, and have bored in them two holes ⅛ in. in diameter, through which are to pass screws to secure them in place. Secure the magnet firmly to the base board, its poles being 9¼ in. from the bottom and at equal distances each side of the centre line. A block of wood at each side of the magnet, another at the bottom, and two clamps—one at each side—ought to secure the magnet firmly in place so that it cannot slip. Then screw the pole pieces into place, taking care that they rest firmly against the inner poles of the magnet. This will leave 1 7-16 in. of clear space between the poles, if the dimensions given have been followed. If the magnet used has dimensions differing from those given at *M* (Fig. 1), allowance will have to be made in the pole pieces so as to leave the proper space between them.

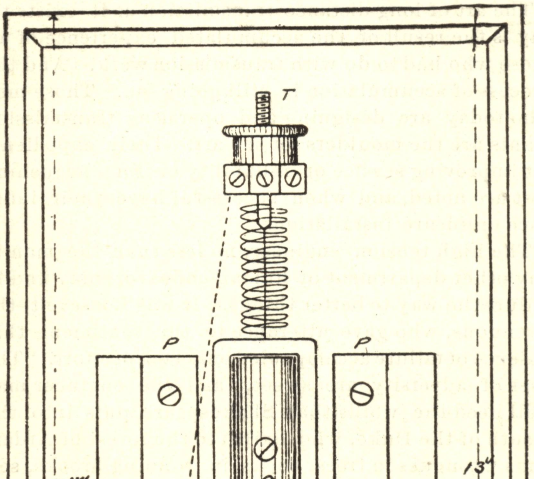


FIG. 2. GENERAL ARRANGEMENT.

In the exact centre of this space is to be secured an iron cylinder, shown in Fig. 2, and also at *C* in Fig. 1. This is 1⅝ in. long and ¾ in. in diameter. It is to be fastened to the base board by a screw passing completely through it. This should leave a clear space of 1-32nd in. on each side of the cylinder. It is well at this point to take a very small, sharp chisel and cut two grooves in the base board, these grooves being extensions backward of the spaces between the poles and the cylinder on each side. These grooves are necessary in order to allow the coil shown in Fig. 2 to swing freely in either direction without striking the back board.

Take next a piece of the thinnest copper procurable. It should be very thin in order to be light and to take up as little space as possible. From the sheet copper make a frame such as is shown at *F* (Fig. 1). It is rectangular in shape and measures 2 in. by ⅞ in. inside, and 2½ in. by 1⅜ in. outside. Its width is ¼ in. As shown in the side view at *K*, it is a frame with the edges bent up so as to form a deep groove running around the face of the frame for holding a coil of fine wire. Where a frame overlaps it must be neatly soldered. At the corners the turned up edges will be cut away, but this will do no harm. Line the slot in this frame with a layer of thin but tough paper, fastened in place by shellac. This serves to insulate the frame, Then wind the slot full of No. 36 single silk-covered magnet wire.

The ends of this coil are left projecting, one at each end. Shellac the outer surface of the coil and set it aside to dry. Now make two little pieces shown at *E* (Fig. 1). They are made by taking a piece of thin copper, ¼ in. by ⅜ in., and soldering to the centre a projecting wire of stiff brass ¼ in. long. Flatten the outer end of the brass wire and drill a small hole through the flattened part. These little pieces are then bound on to the ends of the coil by a silk thread, so that the projecting wires form a spindle about which the coil may rotate. For this reason they may be so adjusted as to project from the exact centre of each end. Also care must be taken in bending them on to insulate them from the coils by slipping a piece of thin paper under them. Then the projecting ends or the coil are soldered to these little strips, one at each end, and the superfluous wire cut off.

Two pieces of brass should be made like those shown at *B* and also at *H* (Fig 1). As shown in Fig 2, these are to support the coil in position. The hole through *B*, therefore, should be ⅜ in. from the back side of the piece, and *H* should slide freely through *B*, but may be secured by a set screw. One of the pieces shown at *H* should be threaded and provided with a thumb nut as shown at *T* (Fig. 2). One end of *H* should be flattened and drilled, as were the ends of the projecting wires on the coil. Now procure some fine silk fibres, preferably of raw silk, and pass one end of the fibre through the hole in the upper wire spindle of the coil, securing it firmly by a drop of sealing wax. In a like manner secure a fibre to the lower spindle. Then, with a *T* in place (Fig. 2) pass the fibre through the hole in *T*, pull it up until it is of the right length, and fasten with sealing wax. Do the same at the bottom and the coil will be suspended so as to swing freely in the space between the cylinder and the poles.

Current is led into and out of the coil by two very small, slender springs shown at the top and bottom. They are made from No. 36 (no finer) German silver wire, coiled around a small pencil so as to make a very weak spring. By carefully removing *T* and leaving the fibre slack, the ends of this coil may be soldered to *T* and to the pivots of the coil. This process should be repeated at the bottom. A circular scale, made of a piece of white Bristol board, projects forward from the instrument and is bent so as to have the axis of the coil for a centre. The radius of the arc of this circle is 2½ in. A pointer (shown in Fig. 1) is glued to the bottom of the coil, and its front end moves over the cardboard scale. This pointer is made by taking a strand from a broom and fitting a thin piece of copper at its outer end to serve as an indicator. The back end of the pointer projects beyond the coil and is counterweighted with a small piece of lead, as shown at *L*.

Thus the silk fibres serve to suspend the coil in place so that it may swing freely, while the coiled springs encircling the fibre carry the current into and out of the coil, and also serve to bring the needle to zero after being deflected. Binding posts at the bottom are connected to the upper and lower suspensions as shown.

If the amateur is skilful he can improve the instrument by using two very fine hair springs in place of tha coiled German silver springs. These may be secured at a watchmaker's, and besides being more reliable, are not so stiff as the German silver springs, and therefore render the instrument more sensitive.—*The American Telephone Journal.*

JUNIOR DEPARTMENT

For the Instruction and Information of Younger Readers.

ELEMENTARY MECHANICS.

J. A. COOLIDGE.

VII. Fluids.

All substances that flow are called fluids, whether they be liquids that are heavy like water, and that exert a noticeable pressure because of their weight, or gases like air, whose weight is not so apparent, and yet flow more readily than liquids and exert pressure everywhere.

The fact that the air that escapes so easily from the tires of our bicycles does not fiy off into space but remains near the earth's surface, shows that it has weight just as all other matter, and consequently exerts a downward force.

We must start with this law:—That fluids exert a pressure in all directions, and that at any given depth in a fluid the pressure is equal in all directions. This may be seen by a simple experiment. Take a common vegetable can and punch small holes, one in the bottom and one or two more at different depths in the side; then thrust it quickly, with the open end up, into a pail of water and it will be seen that the water spirts in through all the holes, but with greatest force through the one in the bottom. The water presses in all directions and has greater pressure the deeper we go.

For our apparatus we need a long necked bottle about 4 in. long and 2 in. diameter, a cork stopple, about 3 in. of rubber tubing ¼ in. diameter inside, 3 in. glass tubing of same diameter, and a file. We must now cut off the bottom of the bottle. This is not an easy task, but with care it can be done successfully.

With the file mark a deep scratch mark (see *ab*, Fig. 20). Heat one end of a poker red hot in the stove, touch first point *a* then point *b*, causing a fine crack to run from *a* to *b*. Draw the red hot poker slowly around the bottle from *b*, and this crack will follow the poker until *a* is reached. The bottom will now come off the bottle, leaving a fairly smooth edge. This can be improved by grinding a little on a whet or grindstone.

From some dentist a piece of thin sheet rubber 3 in. square should be got and tied with a thread over the bottom of the bottle, as in Fig. 21. A small funnel, *F*, should be inserted in one end of the tube, and the glass tube in the other end and then through the cork of the bottle. A hole in the cork for the glass tube may be made with a round file. The whole apparatus will look like Fig. 20 when the bottle is inserted, or like Fig. 21 when the bottle is erect.

EXPERIMENT XV.

Fill bottle, tube and funnel full of water and hold as in Fig. 21. Hold *F* on a level with the top of the bottle and slowly raise it ; as it rises the rubber sheet bulges out, showing a constant increase in the pressure upon it. Keep *F* one foot above *B* and notice the curve of the rubber ; turn the bottle on its side and observe again. Turn the bottle as in Fig. 20 and keep *F* one foot from *B*. In all these we shall find the pressure the same and that the law of "pressure being equal in all directions" is true.

EXPERIMENT XVI.

Take the funnel out, hold the apparatus as in Fig. 20 and pinch the rubber between thumb and finger at *F*. Holding this in one hand, raise the bottle about two feet above *F*, and then let a little water escape at *F*. We then have an illustration of a water system. *B* is one reservoir; *F* the end of a pipe which, after passing under ground through the streets, terminates in a faucet in a house. The higher *B*, is the faster the water flows. Lower *B* and see that when the water is on a level with *F* no water will flow. The distance vertically from *F* to *B* is known as the "head" of water. It is easily seen how necessary it is to have a reservoir in a high place in order to make the water have head enough to flow to all the houses. In some cities water has to be carried many miles in order to find enough difference in level to give sufficient pressure. Ask any plumber to explain to you the pressure gauge with which he tests the water faucets.

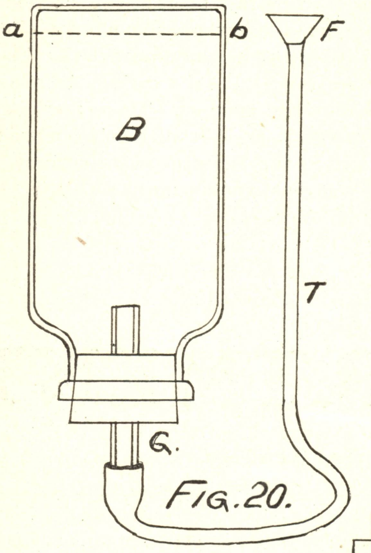


FIG. 20.

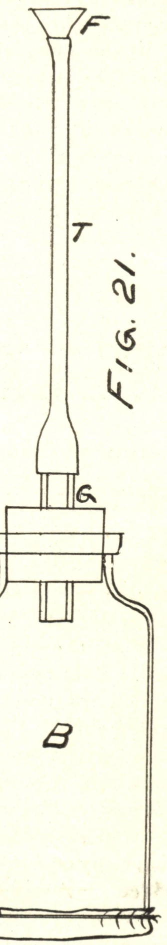


FIG. 21.

About 1648 Pascal learned that if a certain pressure were exerted on a part of the liquid in the interior of a vessel filled with a liquid, every other equal part received the same pressure. He took a strong cask, fitted a tall tube into its head, and then filled the cask and tube with water. Where the tube entered the head of the cask there was a pressure of the weight of the water in the tube. If the tube had an area (or cross section) of .5 sq. in., every other equal portion of the inside of his barrel had an equal pressure. He found the large area inside his barrel suffered so much pressure that his cask burst.

EXPERIMENT XVII.

Set a box *X* with a ruler *R* tied to one side as in Fig. 22. Cut a thin disc of wood, *D*, glue a cork, *L*, to this piece of wood and a long bristle or broom straw, *P*, to the cork. Cut a piece 4x4 in. from a 2 in. plank, and with an extension bit bore a hole, *O*, large enough to hold the neck of our bottle and ¾ in. deep. With bit ½ in. diameter, continue this hole, *S*, nearly to the bottom and bore a hole, *V*, in the side to meet *S*. With tube and bottle filled with water remove funnel, slip the block, *K*, over the tube and neck of bottle and insert in position as seen in Fig. 22. Replace the funnel, *F*, and place disc, *D*, and pointer, *P*, on top of the rubber sheet, *B*. Place the box with ruler, *R*, about ⅛ in. from *P*, so that any rise or fall in *B* can be measured. The rise in *P* will give us the means of measuring any increase in pressure on *B*.

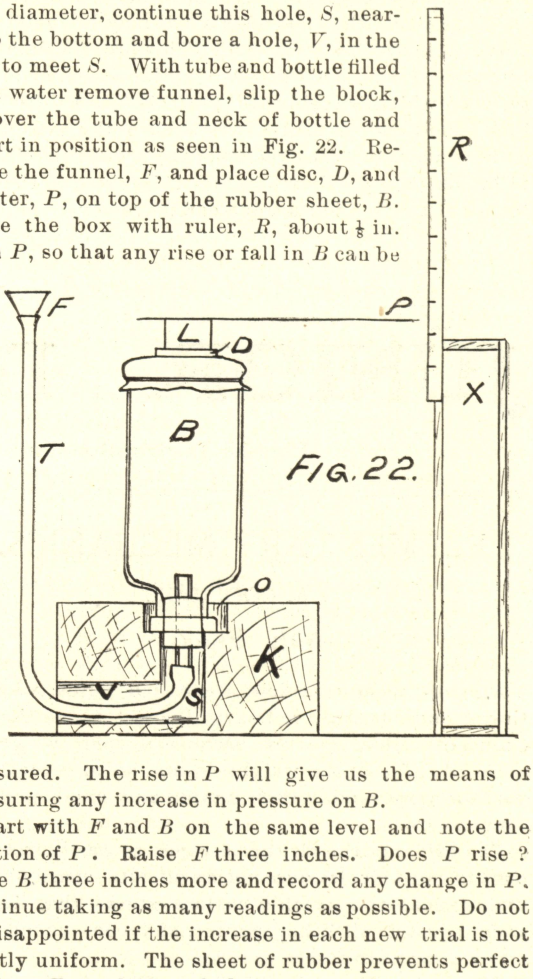


FIG. 22.

Start with *F* and *B* on the same level and note the position of *P*. Raise *F* three inches. Does *P* rise? Raise *B* three inches more and record any change in *P*. Continue taking as many readings as possible. Do not be disappointed if the increase in each new trial is not exactly uniform. The sheet of rubber prevents perfect results. Enough if we find an increase of pressure at *B* for a rise at *F*. What causes this pressure? Can it be the trifling amount of water in the tube *F*?

EXPERIMENT XVIII.

Arrange the apparatus as before, only put a 4 oz. weight on *D*. Note the position of the pointer when *F* is three inches above *B*. Place an 8 oz. weight instead of the 4 oz. weight on *D* and raise *F* until *P* stands where it did before. Try a pound weight on *D* and raise *F* until *P* is in the same place. Manifestly it is not the extra weight of water in *F*, for that amounts to only a small fraction of an ounce for a rise in *F* of three inches. Recall Pascal's barrel and you have the explanation. If the tube is ¼ in. diameter and *F* is raised four inches, the increase in pressure down the tube and upon the opening into the bottle at *T* is only about .1 oz. But this pressure is on an area of only about .05 sq. in., and this is transmitted to every equal area of *B*. If, instead of a rubber tube, we had one of metal entering a metal cylinder instead of a bottle; and if, instead of pouring water into a funnel, a piston were forced down *F*, the water would be forced into the larger cylinder. Now replace *B* with a large piston and we have the essential parts of a hydraulic press. A frame work above *B* must hold the substance to be compressed, and the piston at *F* must be fitted with a lever or pump handle. With such a press a tremendous power is gained, a force of 20 or 30 pounds often producing a pressure of 8 or 10 tons.

CORRESPONDENCE.

Our readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to editor of AMATEUR WORK, 77 Kilby Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if direct answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

No. 78. MELROSE HIGHLANDS, MASS., June 28, '04.

How much wire is needed for the "Sensive Relay" described on page 131 of the April, 1904, AMATEUR WORK? C. W. W.

About one pound of No. 36 cotton covered magnet wire is required for the "Sensitive Relay".

No. 79. MONTREAL, QUE., June 19, '04.

Can I put a 1¾ h. p. engine on an ordinary bicycle, and would it be safe? P. H. R.

Bicycles, as they are now built, are not strong enough to sustain the engine and other equipments. To have a safe motor bicycle it would be desirable to build a complete one with heavy tubing and other parts to match.

No. 80. FRANKLIN, N. H., June 6, '04.

I have made a chloride of silver battery as described in Vol. I., No. 12, but fail to get any current. I used chloride of silver that I purchased at a drug store and sterling silver wire. Can you tell me where the fault lies? J. L. J.

The information you send is not very definite. It is possible that the chloride of silver purchased is not a good solution, but rather more probable that in making your cell you have a short circuit; that is, the negative and positive elements are in contact at some point. Would suggest that you look into the latter and see if the trouble does not lie there.

No. 81. ROCKFORD, ILL., July 1, '04.

I take advantage of your "Correspondence" to ask a few questions which are bothering me. I think most of your electrically inclined readers will welcome more articles on the subject of wireless telegraphy, especially on its operation.

1. (*a*). What capacity condenser does a one-inch coil require? (*b*). A two-inch coil? (*c*). A three-inch coil?

2. A two-inch spark coil requires twice the amount of secondary wire as does a one-inch coil; a three-inch coil three times as much as the one-inch coil. Does the same follow in the case of condensers?

3. If I have two 2-microfarad condensers and connect them in multiple, so to speak, is the resulting capacity four microfarads?

4. Is a water or gas pipe a good ground for wireless telegraph work?

5. Of what material and shape should the air conductor of wireless telegraph apparatus be?

6. Some time since an article appeared in your paper on the construction of a mercury interrupter. Since the primary coil current passed through a spring of fine copper wire, this interrupter would be useless on a coil of any size. How could it be made to interrupt a coil of twenty or thirty amperes?

7. On what size of spark coil do you consider that a mechanical interrupter is more practical than a common vibrating interrupter?

8. Does a mercury or mechanical interrupter require a condenser? R. N. M.

1. (*a*), (*b*), (*c*). The capacity of the condenser to be placed across the contacts of a vibrating interrupter is figured according to the amount of primary battery and speed of make and break. One must put the right capacity of condenser across the primary circuit to reduce sparking contact to a minimum and to give the best output in the secondary. The peculiarities of construction of any one cell preclude giving off hand the absolute condenser capacity necessary. Best results are obtained by experiment in the vicinity of 1 to 2 microfarad for 20 volts primary battery, for any length of secondary spark.

2. The amount of wire used in a secondary does not give spark length. It is how it is wound on in turns and layers. One cannot measure wire length in a coil giving a certain spark, and estimate that twice as much will give twice as great a spark.

3. Two 2-M. F. condensers in multiple give 1 M. F. capacity.

4. Water and gas pipes should not be used for a ground. The best ground is one buried specially for the purpose.

5. See August AMATEUR WORK.

6. The mercury interrupter you mention was for small coils. To handle 20 amperes requires different apparatus. An article covering high current interruption will appear shortly.

7. Vibrating interrupters, if well made, will work all right on any size coil where highest frequency is of no account. Mercury and mechanical interrupters are high speed.

8. Mercury and mechanical interrupters are improved by a condenser across the make and break points. The capacity of such a condenser is a matter of experiment and calculation, based on construction data of the coil and primary battery to be used.

No. 82, MALDEN, MASS., June 1, '04.

Will you please inform me how to make the composition used in the hectograph. I know that gelatine is used, but do not know the proportions. E. P.

The composition is made from the best gelatine and glycerine. One ounce by weight of gelatine is soaked over night in cold water, and in the morning the water is poured off, leaving the swelled gelatine. Six and one-half fluid ounces of glycerine are now heated to about 200° F. (93 C.) on a water bath preferably, and the gelatine is added thereto. The heating is continued for several hours. This operates to expel the water and to give a clear glycerine solution of gelatine.

The composition is then poured into the tray, which must be perfectly level in order to obtain a surface nearly even with the edge. It is then covered so as to keep off the dust. The cover, of course, must not come in contact with the smooth surface. In six hours it will be ready for use.

No. 83. BOSTON MASS., June 14, 1904.

I am making the wireless telegraph apparatus which was described in the June and July, 1902, numbers. Will you kindly answer the following question: When using the apparatus in an exhibition hall can the ground wire be in a box of damp earth instead of the ground? I have been very successful so far in the making. N. A. T., Jr.

The ground wire must have a complete circuit to moist earth, this meaning actual ground contact. If a metal drain pipe from the eaves of the building can be reached from a window, and such drain pipe reaches down into the earth two or three feet in making connection with a sewer, you could temporarily connect your ground wire to the same, making the connection with several turns in connection with the bare metal. A painted pipe would give poor connection. Do not connect with interior pipes, like gas and water pipes, as the voltage is high and might also interfere with telephone and other low tension connections, which are frequently made to interior piping. If this is not possible, it will be advisable to have ground wire put out the nearest window, the earth end having a piece of copper plate about a foot square embedded in moist earth, the connection with the wire and copper plate being soldered.

TRADE NOTES.

Amateur photographers should inquire of dealers for the Franklin developing clips. By means of these clips plates can be handled throughout development without having the hands come in contact with the solutions used, thereby preventing stains and other objectionable features. They are manufactured by Parsell & Weed, 131 West 31st Street, New York City. who also make the Franklin lantern slide vise for holding lantern plates when binding. It is much the best thing obtainable for that purpose. Circulars will be mailed upon request.

The attention of those interested in the equipment of manual training schools is called to the wide range of machines manufactured by the American Wood Working Machinery Company of New York City. An examination of their catalogue shows that this company can fill orders for about every kind of machine needed in woodworking. Scroll, band and circular saws, turning lathes, planers, mortisers in various styles and many sizes. The catalogue of this company will be mailed upon request to those interested in this class of machines. The salesrooms in New York, Chicago, New Orleans and Boston are very convenient to many buyers making it possible for them to have personal inspection of the machines they propose buying.

The large demand for "Oil Stones, How to select and use them." published by the Pike Mfg. Co., Pike, N. H. has required a new edition. This interesting booklet contains much of value to every mechanic. It is mailed upon request, and all readers are recommended to send for it. A new catalogue has also just been issued by this company showing their full line of sharpening stones.

A new catalogue of the Ohio Electric Works. Cleveland, Ohio, shows that this enterprising firm is keeping right up to date in the variety of electrical devices they offer. Send for this catalogue if interested in electrical experimental work.

Drinking water from the barrel cactus is used by the Indians of the desert. The barrel cactus grows among the desert hills west of Torres, Mexico, and the Indians cut the top from a plant about 5 feet high, and with a blunt stake of palo verde, they pound to a pulp the upper six or eight inches of white flesh in the standing trunk. From this, handful by handful, they squeeze the water into the bowl they have made in the top of the trunk, throwing the discarded pulp on the ground. By this process they secure two or three quarts of clear water, slightly salty and slightly bitter to the taste, but of far better quality than some of the water a desert traveler is occasionally compelled to use. The Indians, dipping this water up with their hands drink it with evident pleasure. In times of extreme drought the Indians use this water to mix their meal preparatory to baking it into bread.

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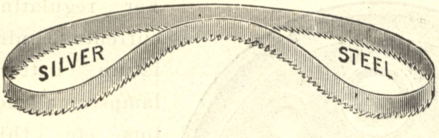

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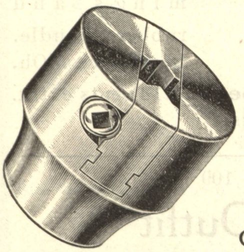

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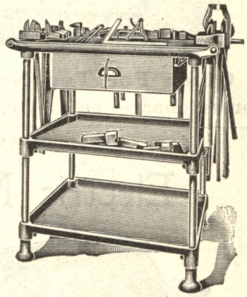

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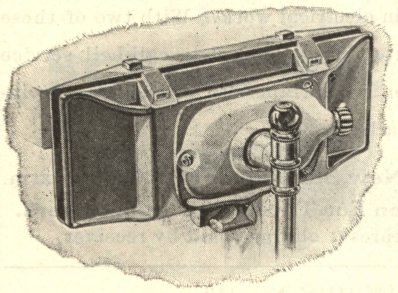

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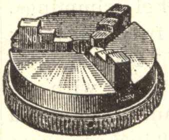

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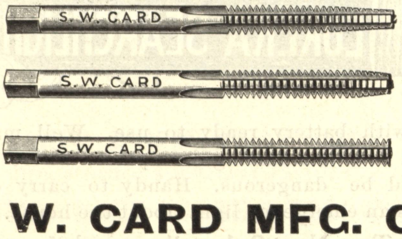

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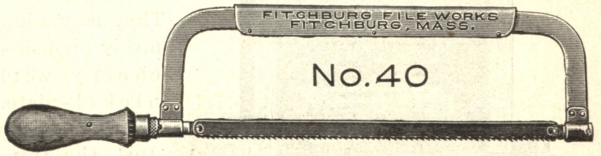

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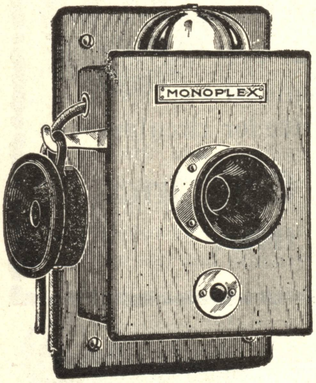

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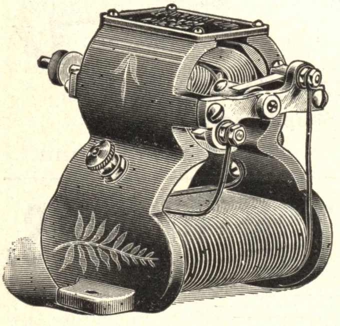

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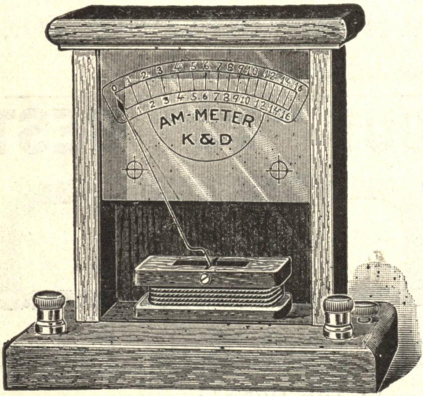

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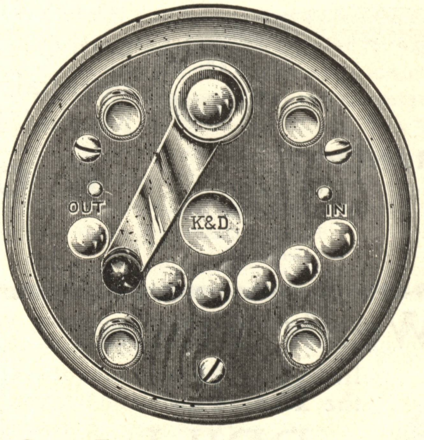

For regulating currents to miniature battery lamps, small motors, etc., this rheostat is just what is wanted. It is well made, and nicely finished with nickel plated trimmings and rubber handle. Resistance 5 Oh.

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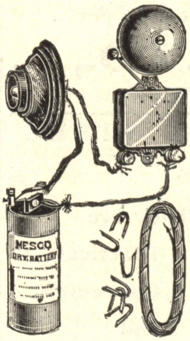

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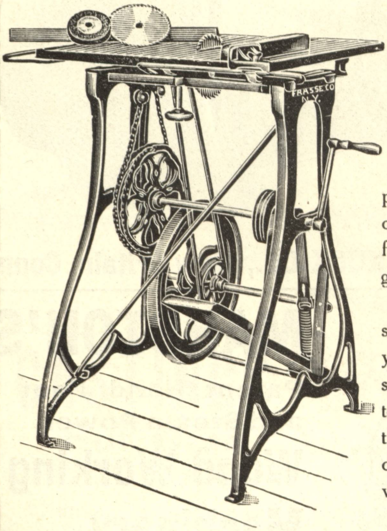
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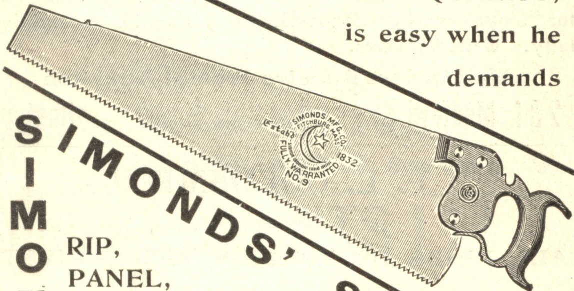

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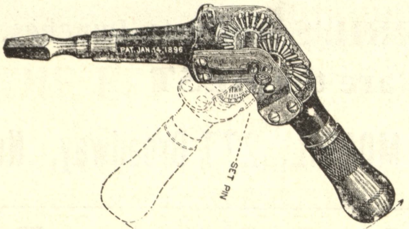

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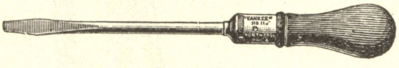

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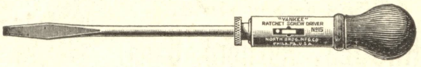
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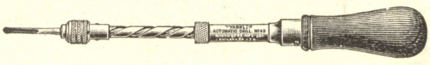

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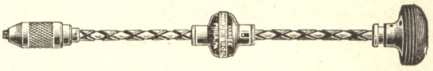

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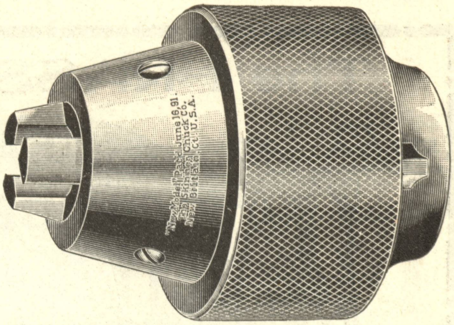

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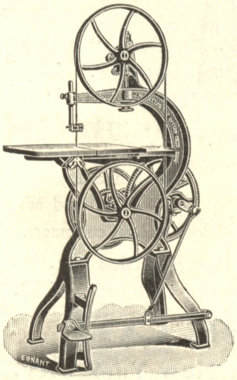

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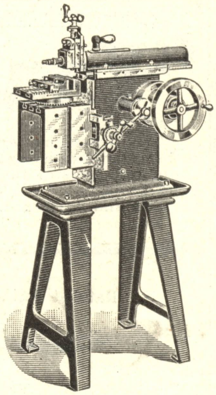

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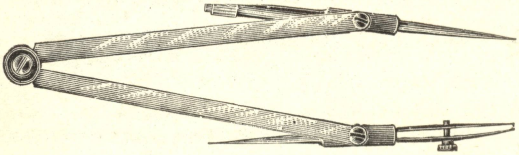

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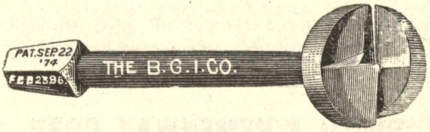

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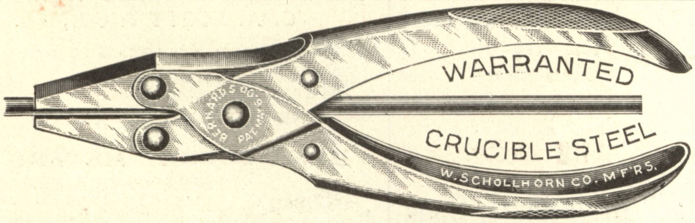

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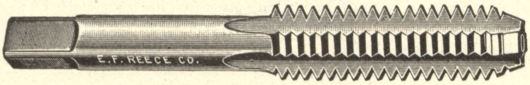

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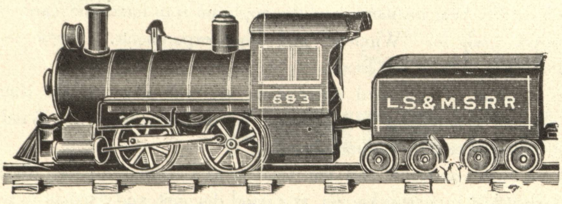

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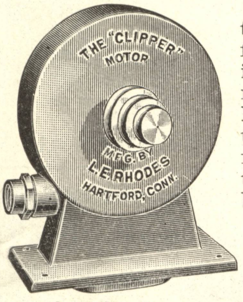

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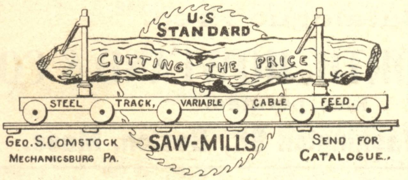
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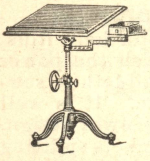

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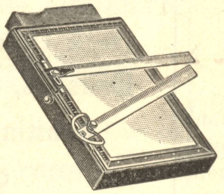

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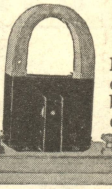

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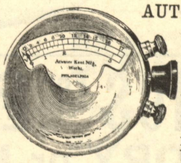

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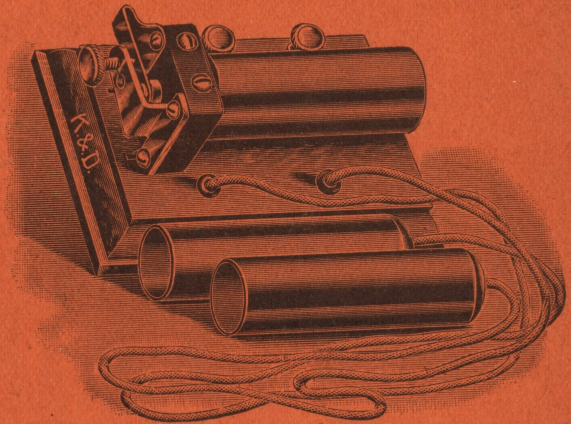

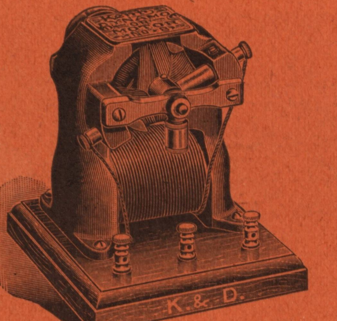

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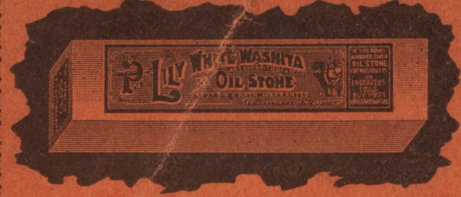

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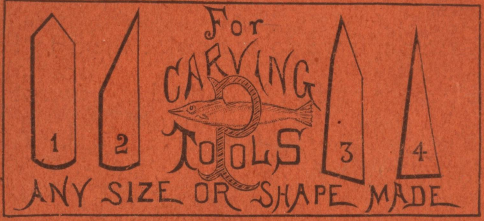

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